55-1510-201-10/4

TECHNICAL MANUAL

OPERATOR'S MANUAL

ARMY MODELS U-8D, RU-8D, AND U-8G AIRCRAFT

This manual supersedes TM 55-1510-201-10/4, 12 February 1969, including all changes.

HEADQUARTERS, DEPARTMENT OF THE ARMY

3 APRIL 1978

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TM 55-1510-201-10/4

This manual is published for the use of all concerned.

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

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Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-31, Operator Requirements for U-8 and RU-8 Aircraft.

WARNING PAGE

WARNING

Personnel performing operations, procedures and practices which are included or implied in this technical manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause serious injury or loss of life.

NOISE LEVELS

Sound pressure levels in this aircraft during some operating conditions exceed the Surgeon General's hearing conservation criteria, as defined in TB MED 251. Hearing protection devices, such as the aviator helmet or ear plugs are required to be worn by all personnel in and around the aircraft during its operation.

STARTING ENGINES

Exposure to exhaust gases shall be avoided since exhaust gases are an irritant to eyes, skin and respiratory systems.

OPERATION OF AIRCRAFT ON THE GROUND

Engines shall be started and operated only by authorized personnel. Reference AR 95-1.

USE OF FIRE EXTINGUISHERS IN CONFINED AREAS

Monobromotrifluoromethane (CF_3Br) is very volatile, but is not easily detected by its odor. Although non-toxic, it must be considered to be about the same as other freons and carbon dioxide, causing danger to personnel primarily by reduction of oxygen available for proper breathing. During operation of the fire extinguisher, ventilate personnel areas with fresh air. The liquid shall not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns because of its very low boiling point.

VERTIGO

The rotating beacon light should be turned off during flight through clouds to prevent sensations of vertigo as a result of reflections of the light on the clouds.

CARBON MONOXIDE

When smoke, suspected carbon monoxide fumes, or symptoms of lack of oxygen (hypoxia) exist, all personnel shall immediately don oxygen masks, and activate the oxygen system.

FUEL AND OIL HANDLING

Fuels and lubricating oils contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary.

SERVICING AIRCRAFT

When conditions permit, the aircraft shall be positioned so that the wind will carry the fuel vapors away from all possible sources of ignition. The fueling unit shall maintain a distance of 20 feet between unit and filler point. A minimum of 10 feet shall be maintained between fueling unit and aircraft.

Prior to refueling, the hose nozzle static ground wire shall be attached to the grounding lugs that are located adjacent to filler openings.

SERVICING BATTERY

Improper service of the nickel-cadmium battery is dangerous and may result in both bodily injury and equipment damage. The battery shall be serviced in accordance with TM 11-6140-203-15-2 by qualified personnel only.

RADIOACTIVE MATERIAL

Instruments contained in this aircraft may contain radioactive material (TB 55-1500-314-25). These items present no radiation hazard to personnel unless seal has been broken due to aging or has accidentally been broken. If seal is suspected to have been broken, notify Radioactive Protective Officer.

RF BURNS

Do not stand near the antennas while they are transmitting.

AIRCRAFT RECOVERY

Use of the U-8/RU-8 aircraft hard points is strictly prohibited for aircraft (airlift) recovery operations. The belly band concept as outlined in FM 55-413 must be used for aircraft (airlift) recovery.

TECHNICAL MANUAL

55-1510-201-10/4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C.

Operator's Manual

ARMY MODEL U-8D, RU-8D AND U-8G AIRCRAFT

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedure, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publication and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MTPS, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished to you.

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CHAPTER 1
INTRODUCTION

1-1. General.

These instructions are for use by the operator. They apply to the U-8D, RU-8D and U-8G aircraft.

1-2. Warnings, Cautions, and Notes.

Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING

An operating procedure, practice, etc., which if not correctly followed could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure, condition, etc., which is essential to highlight.

1-3. Description.

This manual contains the complete operating instructions and procedures for the U-8D, RU-8D and U-8G aircraft. The observance of limitations, performance, and weight/balance data is mandatory. The observance of procedures is mandatory except when modification is required because of multiple emergencies, adverse weather, terrain, etc. Your flying experience is recognized, and therefore, basic flight principles are not included. It is required that THIS MANUAL BE CARRIED IN THE AIRCRAFT AT ALL TIMES.

1-4. Appendix A, References.

Appendix A is a listing of official publications cited within the manual applicable to and available for flight crews.

1-5. Appendix B, Abbreviations and Terms.

Appendix B is a listing of abbreviations and terms used throughout the manual.

1-6. Index.

The index lists, in alphabetical order, every titled paragraph, figure, and table contained in this manual. Chapter 7, Performance Data, shall have an additional index within the chapter.

1-7. Army Aviation Safety Program.

Reports necessary to comply with the safety program are prescribed in AR 385-40.

1-8. Destruction of Army Material to Prevent Enemy Use.

For information concerning destruction of Army material to prevent enemy use, refer to TM 750-244-1-5.

1-9. Equipment Serviceability Criteria.

Equipment serviceability criteria for the U-8D, RU-8D and U-8G are prescribed in TM 55-1510-201-ESC.

1-10. Forms and Records.

Army aviators flight record and aircraft maintenance records which are to be used by crew members are prescribed in TM 38-750 and TM 55-405-9.

1-11. Explanation of Change Symbols.

Changes, except as noted below, to the text and tables, including new material on added pages, are indicated by a vertical line in the outer margin extending close to the entire area of the material affected; exception: pages with emergency markings, which consist of black diagonal lines around three edges, may have the vertical line or change symbol placed along the inner margins. Symbols show current changes only. A miniature

pointing hand symbol is used to denote a change to an illustration. However, a vertical line in the outer margin, rather than miniature pointing hands, is utilized when there have been extensive changes made to an illustration. Change symbols are not utilized to indicate changes in the following:

a. Introductory material.

b. Indexes and tabular data where the change cannot be identified.

c. Blank space resulting from the deletion of text, an illustration or a table.

d. Correction of minor inaccuracies, such as spelling, punctuation, relocation of material, etc., unless correction changes the meaning of instructive information and procedures.

1-12. Aircraft Designation System.

Aircraft series designation of either U-8D, RU-8D, or U-8G, will be used in conjunction with paragraph titles, text content, and figure titles to show effectivity of the material. Any of these series designations may follow a paragraph title or figure title to indicate proper effectivity, unless the material applies to all aircraft series. If the material applies to all series, no series designation will be used. Where practical, descriptive information is condensed and combined for all series to avoid duplication. The designation system prescribed by AR 70-50 is used in aircraft designations as follows:

EXAMPLE RU-8D

R - Modified mission symbol (reconnaissance)

U - Basic mission and type symbol (utility)

8 - Design number

D - Series symbol

1-13. Use of Words Shall, Should, and May.

Within this technical manual the word "shall" is used to indicate a mandatory requirement. The word "should" is used to indicate a nonmandatory but preferred method of accomplishment. The word "may" is used to indicate an acceptable method of accomplishment.

CHAPTER 2

AIRCRAFT AND SYSTEMS DESCRIPTION AND OPERATION

Section I. AIRCRAFT

2-1. Introduction.

The purpose of this chapter is to describe the aircraft and its systems and controls which contribute to the physical act of operating the aircraft. It does not contain descriptions of avionics and mission equipment, covered elsewhere in this manual. This chapter contains descriptive information and does not describe procedures for operation of the aircraft. These procedures are contained within appropriate chapters in the manual. This chapter also contains the emergency equipment installed. This chapter is not designed to provide instructions on the complete mechanical and electrical workings of the various systems; therefore, each is described only in enough detail to make comprehension of that system sufficiently complete to allow for its safe and efficient operation.

2-2. General.

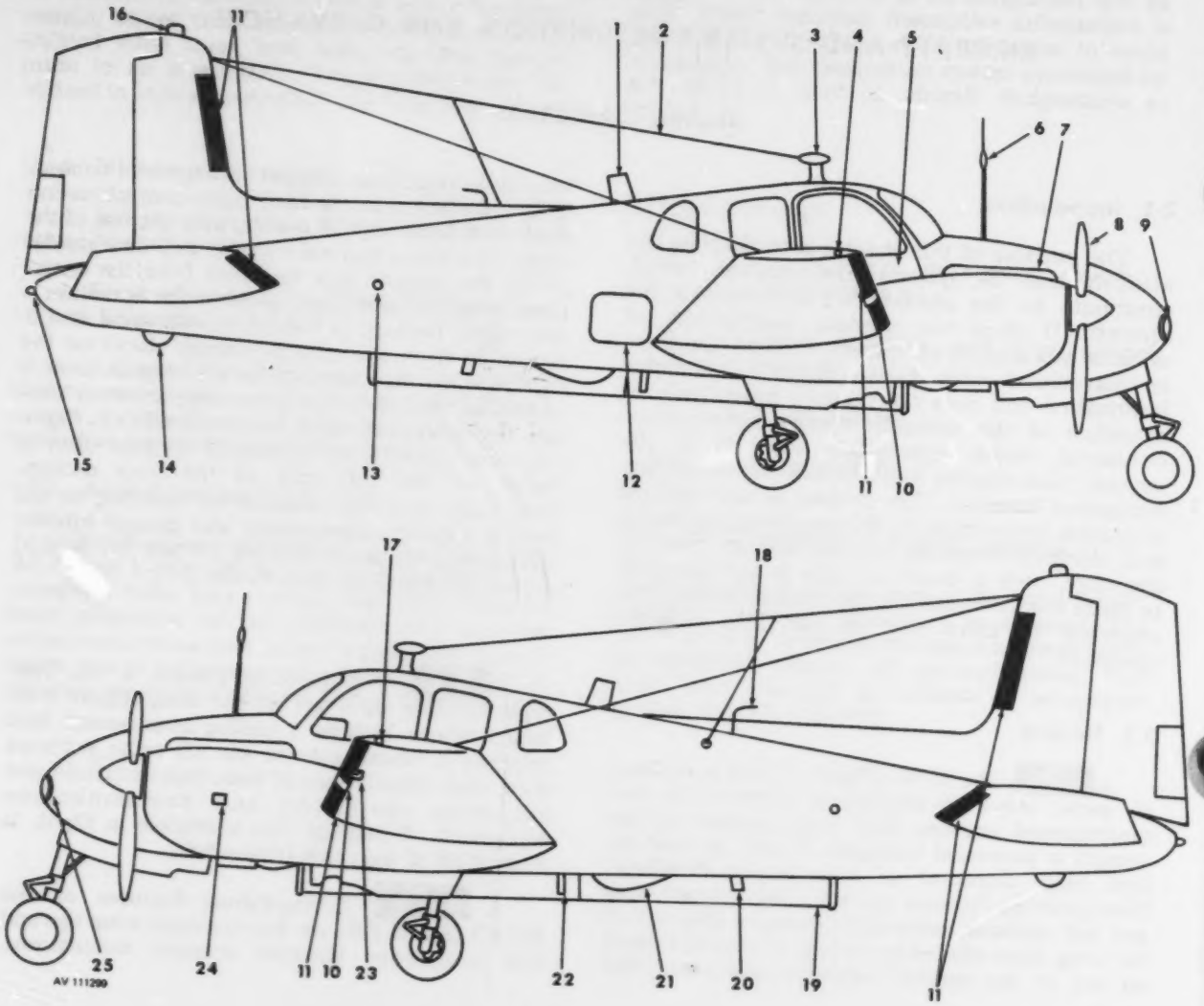
a. U-8D The U-8D (Figure 2-1) is a sixplace, all metal low-wing monoplane powered by two supercharged engines. The basic mission of the aircraft is personnel transport. It may be used for light cargo transport or other liaison functions. Distinguishing features are the square-tipped wing and tail surfaces, retractable entrance step aft of the wing, three-bladed propellers, a rotating beacon on top of the vertical stabilizer, and retractable tricycle landing gear. Interior arrangement consists of two 3-place seats. Normal flight control station is the left front seat. However, with the use of the single throwover control column and dual rudder pedals the aircraft may be flown from the center front seat. Minimum crew required for operation is one pilot. Baggage is carried in two areas and is accessible from the ground through doors on the right side of the aircraft. The aft baggage areas is accessible in flight. The nose compartment, used also for radio equipment, is not accessible in flight. On some aircraft, an additional baggage door is found on the left side of the nose section. Familiarity may be obtained by referring to the general exterior arrangement and general interior arrangement diagrams (figures 2-1 and 2-7 or 2-5) and main differences table (Table 2-1).

b. U-8G Distinguishing feature is the stair type entrance door aft of the wing (figure 2-2). Modifications include a seating arrangement that provides a center aisle to the aft cabin entrance door, dual installations of basic flight controls, and extensive navigation and communications equipment. A baggage area accessible in flight, is located aft of the cabin (figure 2-6).

c. RU-8D Distinguishing features of the RU-8D (figure 2-3) are the extended wing tips and the numerous external antenna installations.

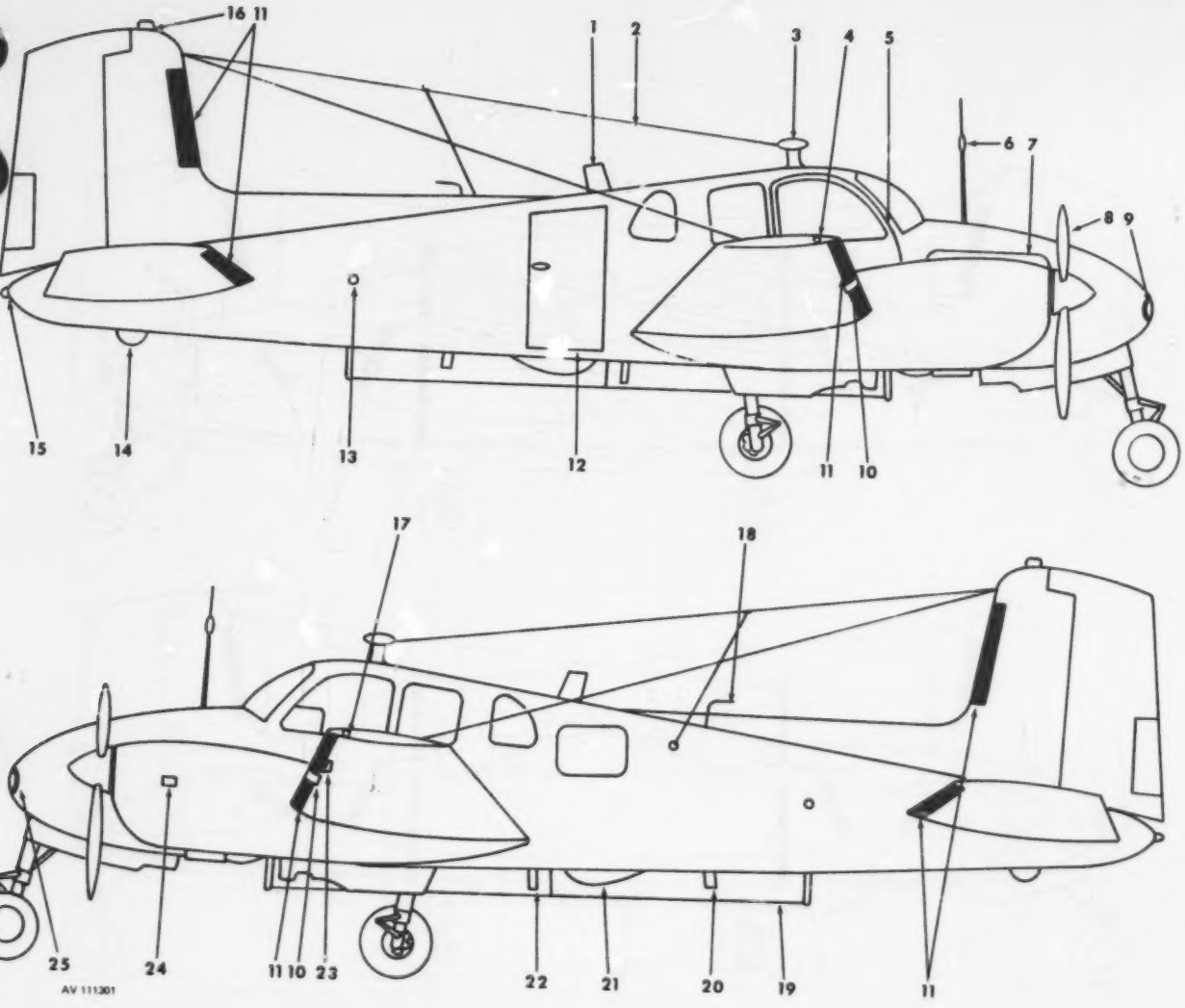
Table 2-1. Main Differences

ITEM	U-8D	U-8G	RU-8D
Maximum gross weight	7300 Lb	7350 Lb	7350 Lb
Maximum landing weight	7000 Lb	7000 Lb	7000 Lb
Radar equipment	No	No	Yes
Cabin entrance step	Yes	Yes	No
Extended wing tips	No	No	Yes
Center aisle	No	Yes	No
Engine preheat ducts	Yes	Yes	No



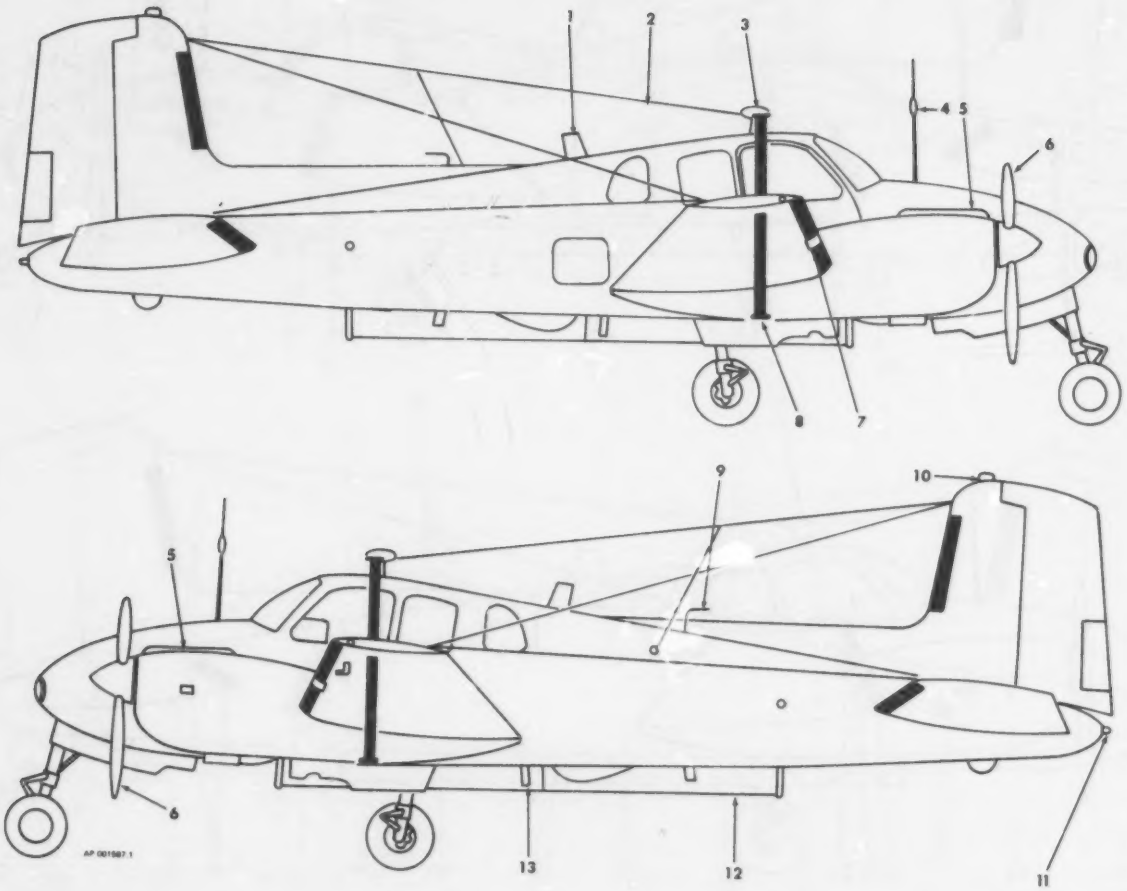
1. VHF antenna
2. HF antenna
3. VOR glideslope antenna
4. Nav light (green)
5. Main entrance door
6. FM antenna
7. Nose compartment access door
8. Propeller
9. Passing (taxi) light
10. Landing lights
11. Deicer boots
12. Aft baggage area access door
13. Static air source
14. Bumper installation
15. Nav light (white)
16. Rotating beacon
17. Nav light (red)
18. Emergency VHF antenna
19. ADF sense antenna
20. Transponder antenna
21. ADF loop antenna
22. UHF antenna
23. Pitot tube
24. External power receptacle
25. Heat and vent air intake

Figure 2-1. General Exterior Arrangement U 8D



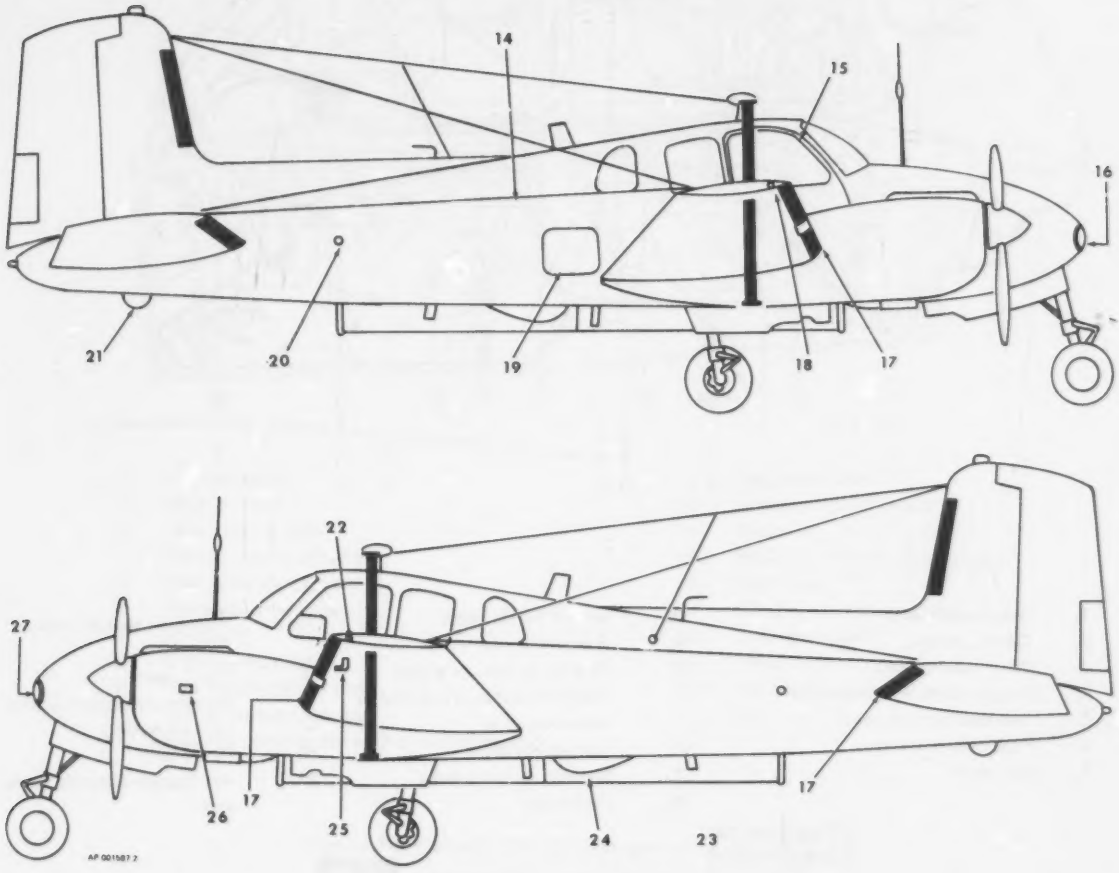
1. VHF antenna
2. HF antenna
3. VOR glideslope antenna
4. Nav light (green)
5. Main entrance door
6. FM antenna
7. Nose compartment access door
8. Propeller
9. Taxi light
10. Landing lights
11. Deicer boots
12. Aft entrance cabin door
13. Static air source
14. Bumper installation
15. Nav light (white)
16. Rotating beacon
17. Nav light (red)
18. Emergency VHF antenna
19. ADF sense antenna
20. Transponder antenna
21. ADF loop antenna
22. UHF antenna
23. Pitot tube
24. External power receptacle
25. Heat and vent air intake

Figure 2-2. General Exterior Arrangement U 8G



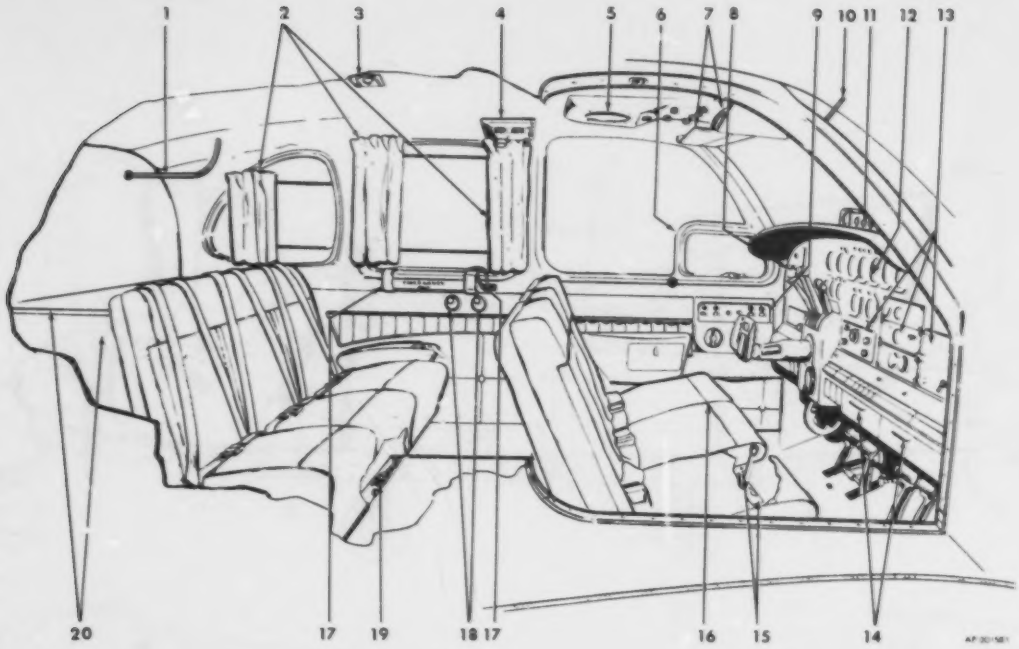
1. VHF antenna
2. HF antenna
3. VOR glideslope antenna
4. FM antenna
5. Nose compartment access door
6. Propeller
7. Landing lights
8. Mission antennas
9. Emergency VHF antenna
10. Rotating beacon
11. Nav light (white)
12. ADF sense antenna
13. UHF antenna

Figure 2-3. General Exterior Arrangement RU-8D *(sheet 1 of 2)*



14. Ground plane antenna
15. Main entrance door
16. Taxi light
17. Deicer boots
18. NAV light (green)
19. Aft baggage area access door
20. Static air source
21. Bumper installation
22. NAV light (red)
23. Transponder antenna
24. ADF loop antenna
25. Pitot tube
26. External power receptacle
27. Heat and vent air intake

Figure 2-3. General Exterior Arrangement RU - 8D *(sheet 2 of 2)*



1. Coat hanger rack
2. Cabin curtains
3. Cabin reading light
4. Oxygen control console
5. Overhead control panel
6. Pilot's storm window
7. Sun visors
8. Engine switch panel
9. Fuel system control panel
10. Free air temperature gage
11. Magnetic compass and cold air outlet housing
12. Instrument panel
13. Avionic control panels
14. Subpanels
15. Engine oil shutoff valve handles
16. Pilot's seat
17. Window emergency release
18. Cold air outlets
19. Relief tube
20. Aft baggage area and access shelf

Figure 2-4. General Interior Arrangement U-8D

Modifications include navigation equipment in place of the aft baggage area and an equipment operator's seat in place of the passenger seating. The baggage area is on the left side of the nose section. Familiarity may be obtained by referring to the general exterior arrangement and interior arrangement diagrams (figures 2-3 and 2-17) and the main differences table (Table 2-1).

2-3. Dimensions.

a. Overall aircraft dimensions are as follows: U-8D U-8G (figure 2-8).

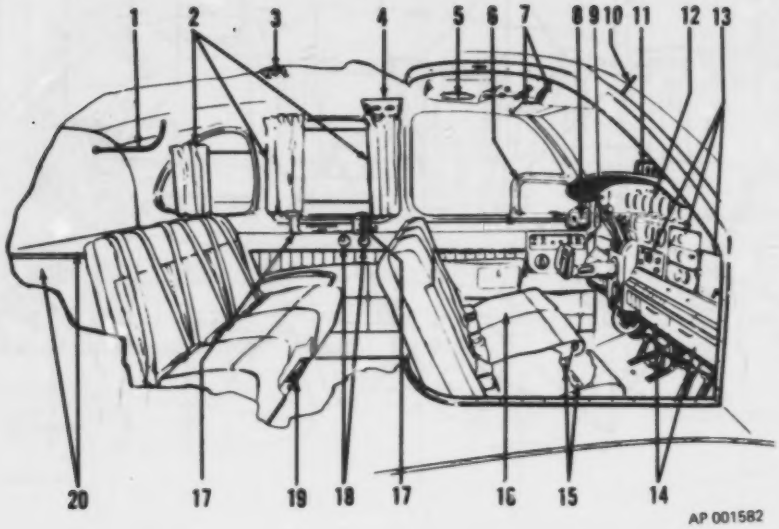
Wing Span	45 ft. 3.375 in
Length	31 ft 6.469 in
Height (at rest)	11 ft 6.5 in
Tread (between center lines of main wheels)	12 ft 9 in

b. RU-8D (figure 2-9).

Wing Span	50 ft 2.375 in
Length	31 ft 6.469 in
Height (at rest)	11 ft 6.5 in
Tread (between center line of main wheels)	12 ft 9 in

2-4. Ground Turning Radius.

Minimum ground turning radius of U-8D and U-8G aircraft is 32 ft 5 in. Minimum ground



1. Coat hanger rack
2. Cabin curtains
3. Cabin reading light
4. Oxygen control console
5. Overhead control panel
6. Pilot's storm window
7. Sun visors
8. Engine switch panel
9. Fuel system control panel
10. Free air temperature gage
11. Magnetic compass and cold air outlet housing
12. Instrument panel
13. Avionics control panels
14. Subpanel
15. Engine oil shutoff valve handles
16. Pilot's seat
17. Window emergency release
18. Cold air outlets
19. Relief tube
20. Aft baggage area and access shelf

Figure 2-5. General Interior Arrangement U-8D ASAC

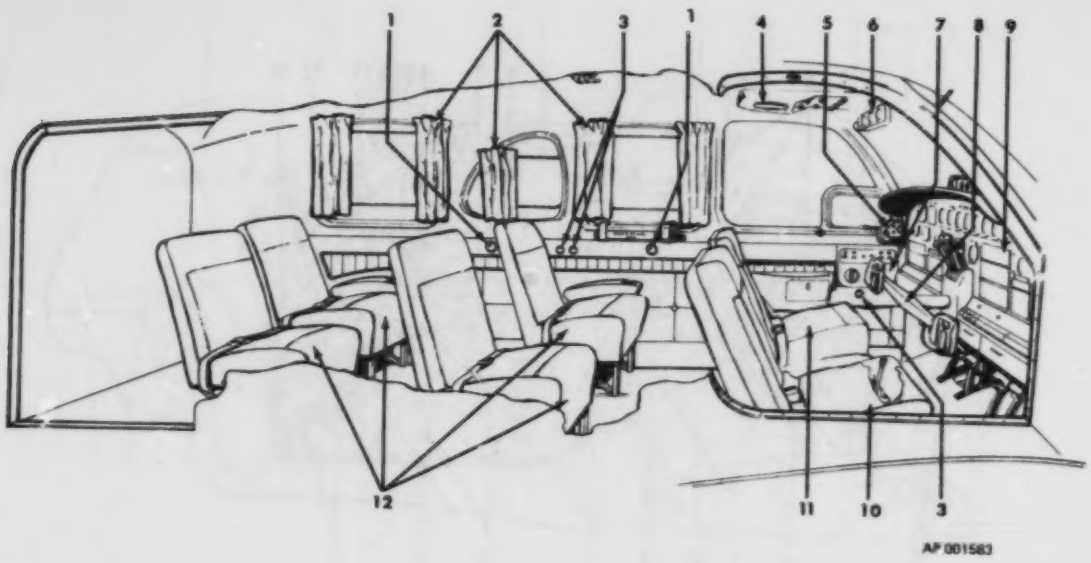
turning radius for RU-8D aircraft is 34 ft 11 in (figure 2-10).

2-5. Maximum Weights.

Maximum gross landing weight of U-8D, RU-8D and U-8G is 7000 pounds. Maximum gross takeoff weight of the U-8D is 7300 pounds. Maximum gross takeoff weight of the U-8G and RU-8D is 7350 pounds. Maximum ramp weight of U-8D is 7350 pounds. Maximum ramp weight of U-8G and RU-8D is 7400 pounds.

2-6. Landing Gear System.

The retractable, tricycle landing gear is electrically operated by a single DC motor which drives the landing gear actuators through a gearbox and torque tube arrangement. In the retract position, the main and nose wheels protrude from the aircraft to provide sufficient clearance between the fuselage and the ground to substantially reduce damage to the aircraft during a wheels up landing. Structural provisions incorporated into the wheel wells are adequate for supporting the weight of the aircraft in this condition. The landing gear is positively locked, when extended, by spring-loaded locks. No up-locks are used. The work gear mechanism of the jack screws hold the landing gear in position. A friction clutch is incorporated into the gearbox to prevent overloads on the motor. The landing gear motor is protected by a 50-ampere circuit breaker, located on the floorboard adjacent to the emergency landing gear extension handle (figure 2-14). Fairing doors are opened and closed mechanically by movement of



1. Cold air outlet
2. Cabin curtains
3. Oxygen distribution outlets
4. Overhead control panel
5. Engine switch panel
6. Overhead instrument panel
7. Fuel system control panel
8. Dual control column
9. Avionics control panels
10. Copilot's seat
11. Pilot's seat
12. Passenger seats

Figure 2-6. General Interior Arrangement U · 8G

the landing gear. When the landing gear is retracted, the nosewheel is automatically centered and the rudder pedals relieved of the steering load. Accidental retraction of the landing gear is prevented by a safety switch mounted on the right main landing gear shock strut. This switch prevents the landing gear from being retracted while the aircraft is on the ground by insuring that the main struts are fully extended before it is possible to retract the landing gear. Gear extension or retraction time is approximately 6 seconds.

CAUTION

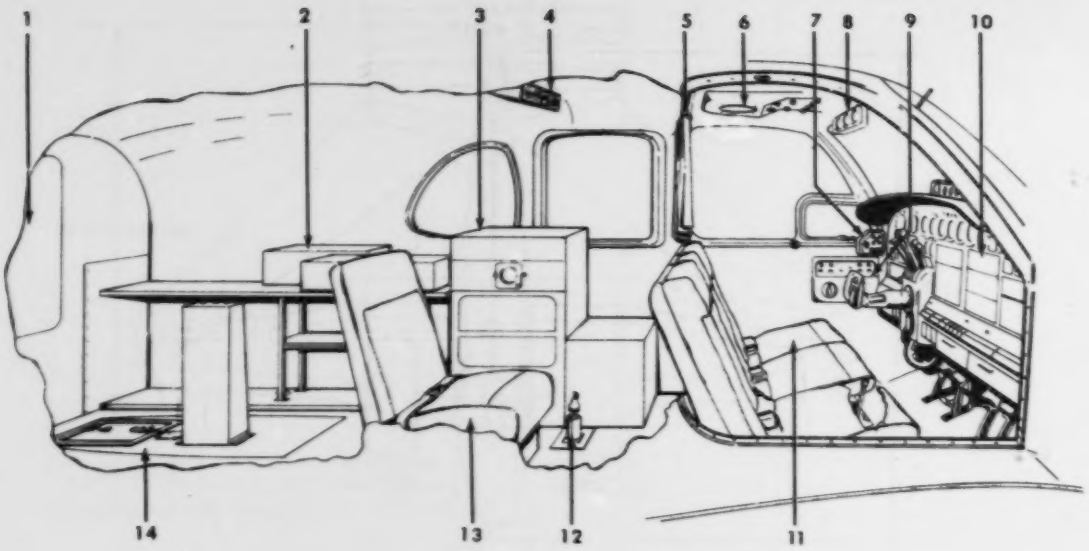
Do not move the landing gear handle while the aircraft is on the ground. Movement of the landing gear handle could result in on-the-ground retraction of the landing gear.

a. Landing Gear Handle. Control of the landing gear motor is provided by a two-position landing gear handle located on the right subpanel (figure 2-11, 2-12 or 2-13). A landing gear switch is mechanically actuated by the landing gear handle which is formed in the shape of a wheel, and has two placarded positions, UP and DOWN.

NOTE

A spring-loaded lock, mounted just below and to the left of the landing gear handle prevents accidental retraction of the landing gear. The lock must be pushed to the left before the landing gear handle can be moved into the UP or DOWN position.

b. Landing Gear Warning Light. A red warning light, inside the transparent wheel-shaped landing gear handle, causes the handle to glow red any time the landing gear is in transit or in a position, not corresponding to the position of the landing gear handle. The handle will also glow red when one or both throttles are retarded below a manifold pressure equivalent to or below the throttle warning horn microswitch setting, unless the landing gear is down and locked. Under single-engine operation, the warning light may be turned off by advancing the throttle of the inoperative engine to a position at or above the



AF 001584

1. Radar equipment junction box (AN/ASN-64)
2. Mission equipment rack
3. Console (ARD-15)
4. Power distribution circuit breaker panel
5. Compartment divider curtain (including window blackout panels)
6. Overhead control panel
7. Engine switch panel
8. Overhead instrument panel
9. Fuel system control panel
10. Avionics control panels
11. Pilot's seat
12. Driftmeter (B-3)
13. Equipment operator's seat
14. Survival gear pallet

Figure 2-7. General Interior Arrangement RU - 8D

throttle warning horn microswitch setting. Lowering the landing gear will also turn the light off during single-engine operation. The circuit is protected by a 3-ampere WARNING HORN circuit breaker, located on the right subpanel (figure 2-11, 2-12 or 2-13).

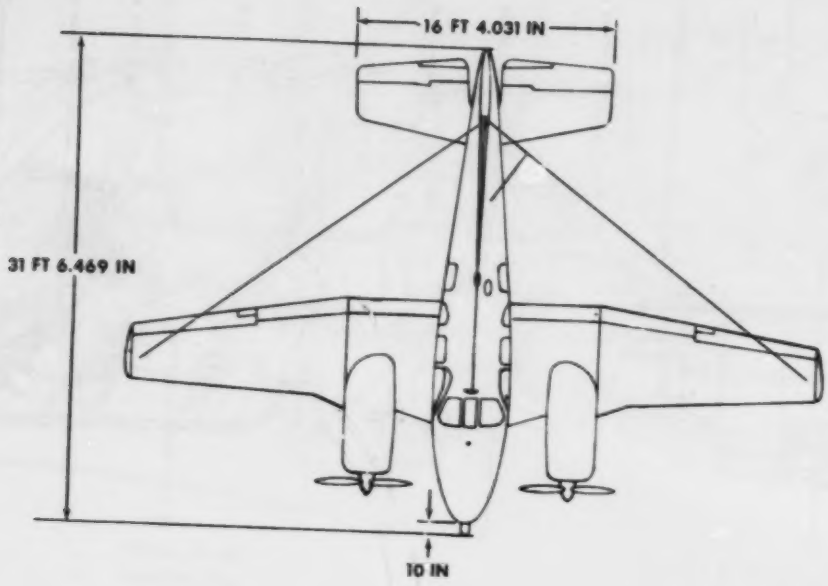
c. Landing Gear Warning Light Test Button. A landing gear warning light test button is located on the right side of the instrument panel (figure 2-25, 2-26 and 2-27). Failure of the landing gear handle to light when the test button is pushed indicates a defective bulb or circuit.

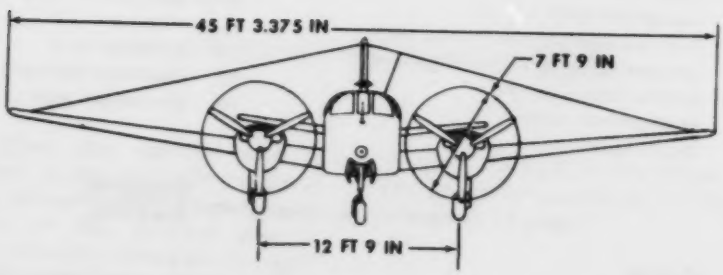
d. Landing Gear Warning Horn. A landing gear warning horn located behind the instrument panel sounds intermittently any time the landing gear is not down and locked in flight when one or both throttles are retarded to or below the specified throttle warning horn microswitch setting. In flight, when any landing gear is not locked down, the horn circuit is energized and retarding either throttle to the specified setting, closes a microswitch which completes the circuit through the horn. A 3-ampere WARNING HORN circuit breaker is located on the right subpanel (figure 2-11, 2-12 or 2-13).

NOTE

The stall warning horn, also located behind the instrument panel, sounds continuously to indicate the approach of a stall.

e. Landing Gear Warning Horn Silence Button. The landing gear warning horn may be silenced by pressing the landing gear WARNING HORN SILENCER button, located on the right side of the instrument panel (figure 2-25, 2-26 or 2-27) adjacent to the landing gear warning light test





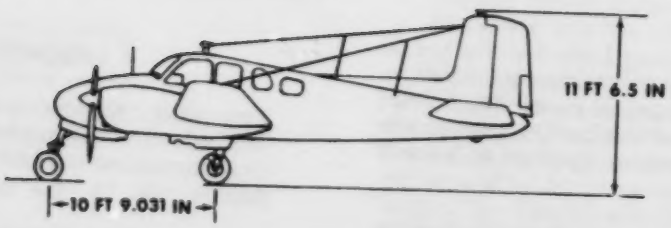


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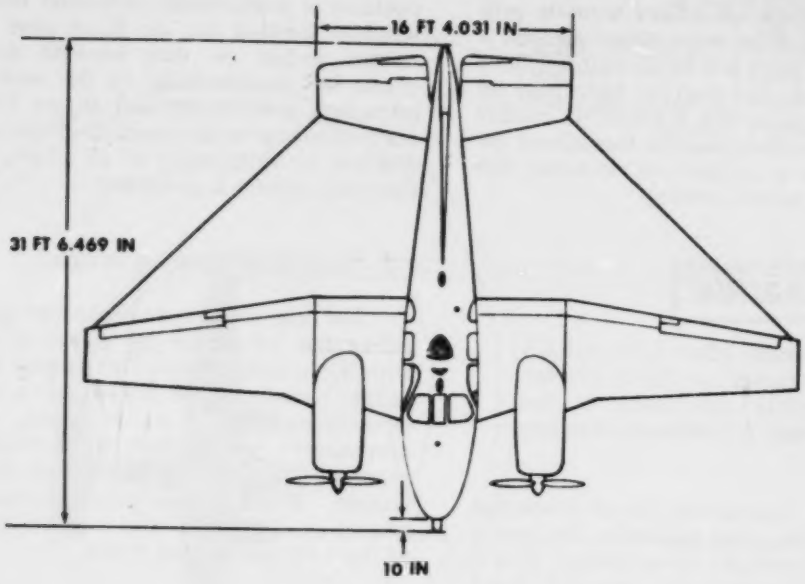
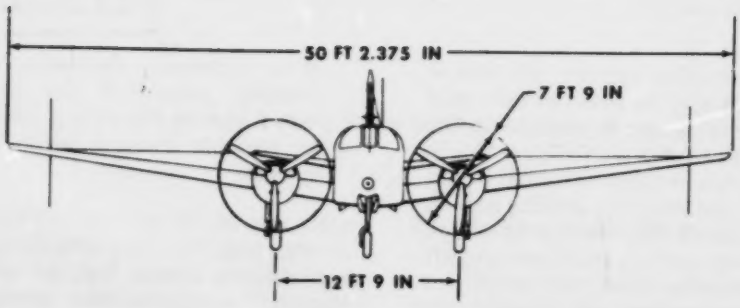
Figure 2-8. Principal Dimensions U 8D U 8G





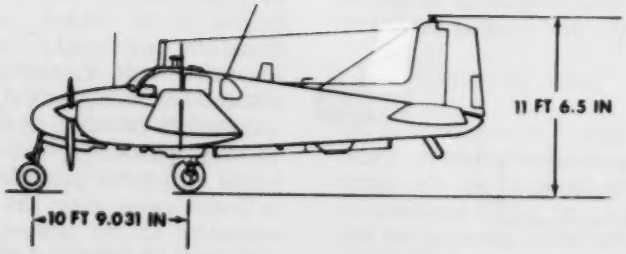


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Figure 2-9. Principal Dimensions RU-8D

button. After silencing the warning horn, subsequent advancement of either throttle will again reset the circuit; thus, when either throttle is retarded, the warning horn will again sound. Under single-engine operation, the warning horn may be silenced by either pressing the WARNING HORN SILENCER button or advancing the throttle of the inoperative engine to a position at or above the throttle warning horn switch setting.

CAUTION

Do not pump handle after LDG GEAR DOWN position indicator lights (3) are illuminated. Further movement of the handle could damage the drive mechanism.

f. Landing Gear Emergency Clutch Disengage Lever. To lower landing gear manually, the motor must be disengaged from the drive system. This is accomplished with the manually operated clutch disengage lever located adjacent to the emergency landing gear handle (figure 2-14). To disengage the clutch, move the lever to the right; to engage, move to the left.

g. Landing Gear Emergency Extension Handle. The landing gear may be lowered manually by operation of a telescoping handle located on the floor at the center of the front seat (figure 2-14). The handle operates a ratchet gear attached to the actuating torque tube, enabling the landing gear to be lowered, but not raised. The handle is pulled out for increased leverage and pumped fore-and-aft to operate the ratchet. Refer to Chapter 9 for landing gear emergency extension procedures.

NOTE

Before operating the landing gear extension handle pull the landing gear relay circuit breaker.

h. Landing Gear Position Indicator Lights. Position of each landing gear is indicated by three individual indicator lights located on the right subpanel, (figure 2-11, 2-12 or 2-13) adjacent to the landing gear handle. The lights, operated by the aircraft DC power system, are placarded L MAIN, NOSE and R MAIN, illuminate when the corresponding landing gear reaches the down and locked position. The system is protected by a 3-ampere, circuit breaker on the right subpanel.

i. Nose Gear Position Indicator. Nose wheel position is additionally indicated through a small window located on the floor near the copilot's rudder pedals. A plate beneath the window is connected mechanically to the nose landing gear retraction mechanism and shows UP or DOWN, corresponding to the position of the nose gear. The window is illuminated at all times when the DC electrical system is operating.

2-7. Nose Wheel Steering System.

The nose wheel is steerable through 15 degrees either side of center by means of direct linkage with the rudder pedals. This linkage also serves as a rudder restraint when the aircraft is on the ground. Operating (taxi) shock loads, which would normally be transmitted to the rudder pedals, are absorbed by a spring mechanism in the steering linkage. When the nose wheel retracts, the steering linkage is disengaged and a guide track at the top of the strut centers the wheel.

2-8. Wheel Brake System.

CAUTION

It is extremely damaging to an aircraft braking system if the pilot applies a continuous braking drag over an appreciable distance while taxiing at slow speeds.

The main landing wheels are equipped with single-disc hydraulic brakes actuated by master cylinders at the rudder pedals. Fluid from a reservoir in the nose compartment supplies the master cylinders. Toe action on the rudder pedals applies brake pressure to the corresponding wheel. No emergency brake system is provided. The importance of proper braking techniques cannot be over-emphasized. The fundamental purpose of the brakes is to retard motion, using friction to transform mechanical energy into heat energy. Repeated and excessive application of brakes, without allowing sufficient time for cooling to accumulate between applications, will cause loss of braking efficiency, possible failure of brake or wheel structure, possible blowout of tires, and in extreme cases may cause the wheel and brake assembly to be destroyed by fire. The brakes should not be dragged while taxiing, and should be utiiized as little as possible for turning the aircraft. Parking brakes shall not be set during flight. The following precautions should be observed insofar as practical:

VERTICAL CLEARANCES		
	U-8D, U-8G	RU-8D
VERTICAL STABILIZER	11 FT. 7 IN.	11 FT. 7 IN.
WING TIPS	6 FT. 6 IN.	6 FT. 10 IN.
PROPELLER– MAXIMUM	9 FT. 3 IN.	9 FT. 3 IN.
MINIMUM	1 FT. 6 IN.	1 FT. 6 IN.

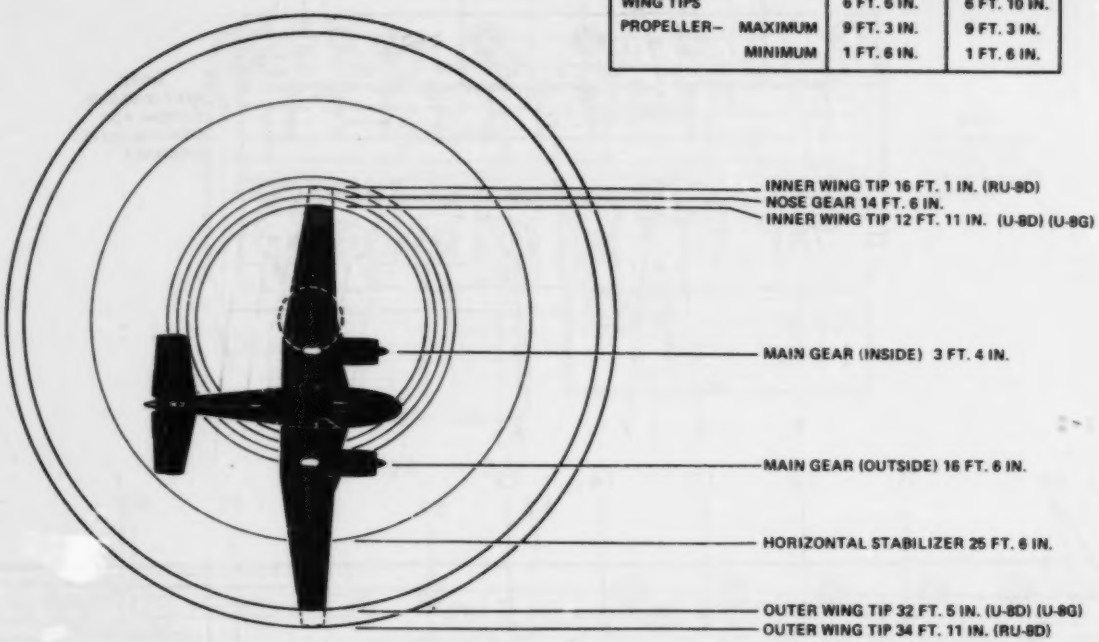
INNER WING TIP 16 FT. 1 IN. (RU-8D)
NOSE GEAR 14 FT. 6 IN.
INNER WING TIP 12 FT. 11 IN. (U-8D) (U-8G)
MAIN GEAR (INSIDE) 3 FT. 4 IN.
MAIN GEAR (OUTSIDE) 16 FT. 6 IN.
HORIZONTAL STABILIZER 25 FT. 6 IN.
OUTER WING TIP 32 FT. 5 IN. (U-8D) (U-8G)
OUTER WING TIP 34 FT. 11 IN. (RU-8D)
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Figure 2-10. Turning Radius and Ground Clearance

a. Immediately after landing or at any time when there is considerable lift on the wings, extreme care should be used during any braking application to prevent skidding the tires and causing flat spots. Proper traction cannot be expected until the tires are carrying the aircraft weight. In the event that maximum braking is required after touchdown, the brakes should be applied smoothly and evenly to the end of the ground roll.

b. With the wheels remaining in the slipstream (extended), at least 10 minutes should be allowed to elapse between landings where maximum braking is applied in order to allow adequate time for cooling between brake applications.

c. With the landing gear retracted, at least 30 minutes should be allowed to elapse between maximum-brake application landings, in order to allow adequate time for cooling.

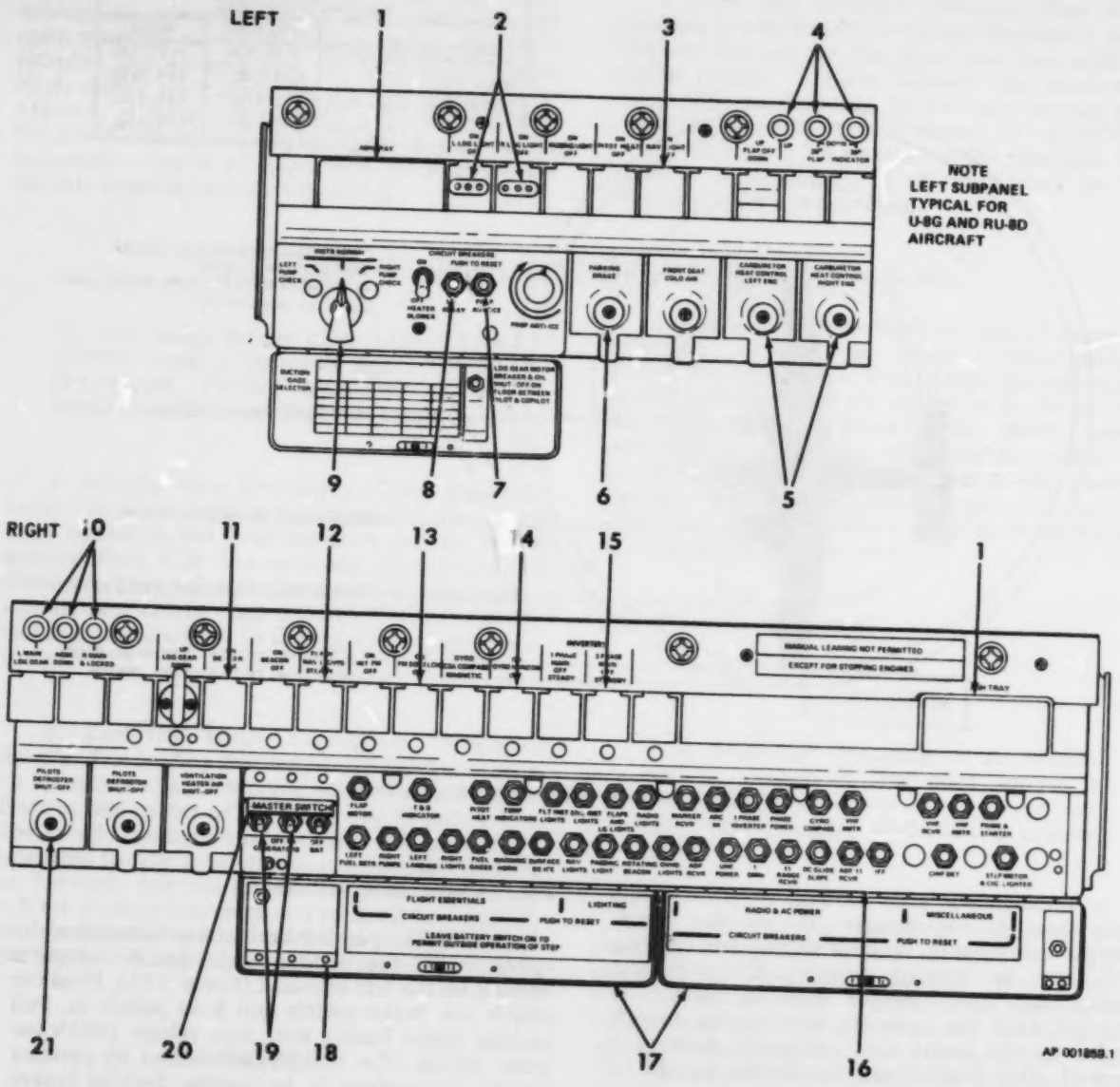
2-9. Parking Brake Handle.

Setting the parking brakes is accomplished by operation of the parking brake handle which is located on the left subpanel (figure 2-11). Press the pilot's toe brake pedals and hold pedals in. Pull parking brake handle out, then release pilot's toe brake pedals. The brakes are released by pressing pedals and pushing in on handle. Parking brakes can be set by operating the left set of rudder pedal toe brakes only.

2-10. Entrance and Exit Provisions. U-8D RU-8D

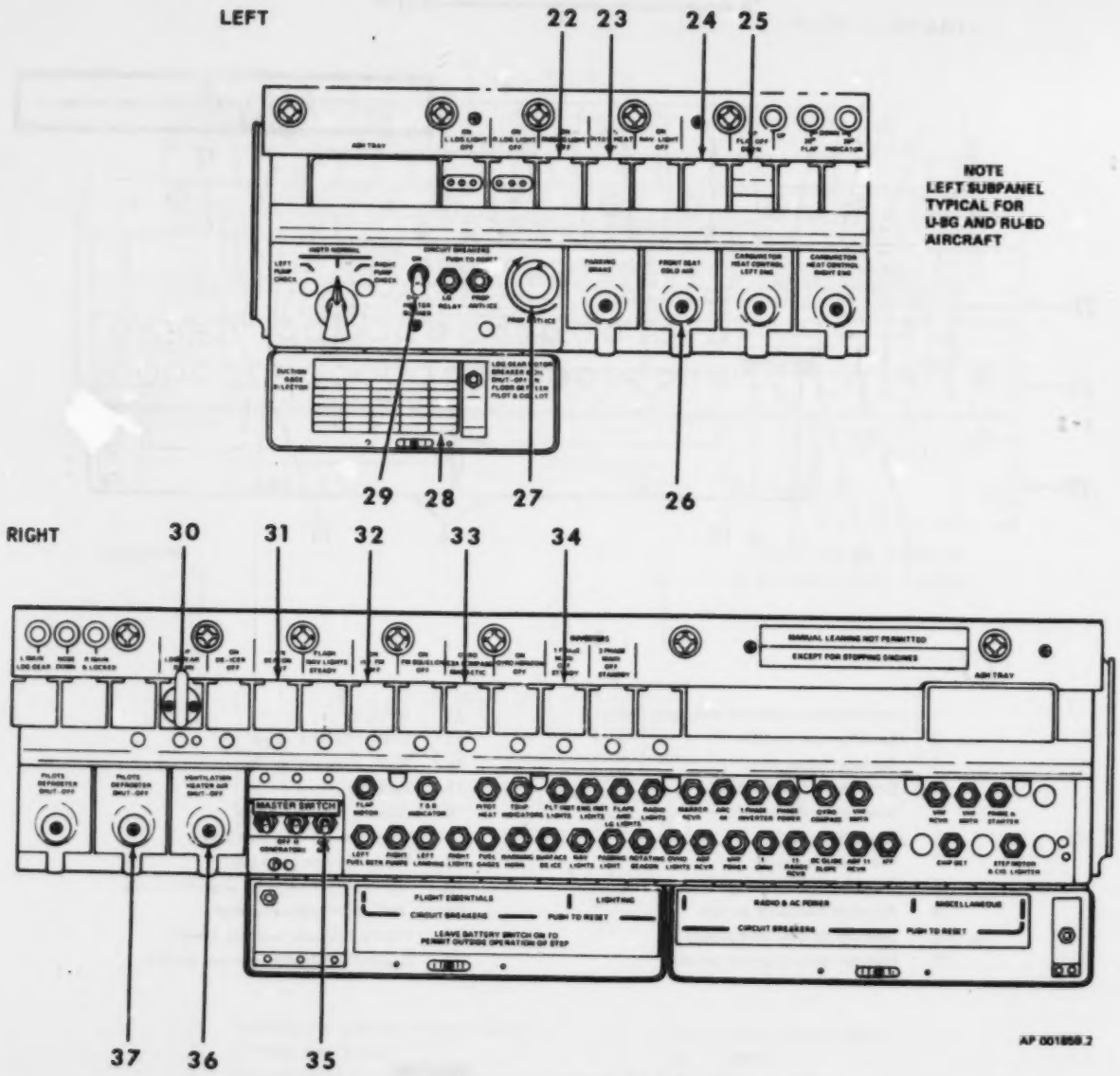
WARNING

The center side windows should never be opened in flight. Under no circumstances should a bailout be attempted through the windows.



1. Ash tray
2. Landing light switches
3. Navigation lights switch
4. Wing flap position indicator lights
5. Carburetor heat control handles
6. Parking brake handle
7. Propeller anti-ice circuit breaker
8. Landing gear relay circuit breaker
9. Suction gage selector
10. Landing gear position indicator lights
11. Surface deicer switch
12. Navigation lights switch
13. FM squelch switch
14. Attitude indicator switch
15. Three-phase inverter switch
16. Circuit breaker panel
17. Right subpanel doors
18. Guard
19. Generator master switches
20. Master switch gang bar
21. Pilot's defroster control handle

Figure 2-11. Subpanels U 8D *(Typical) (sheet 1 of 2)*

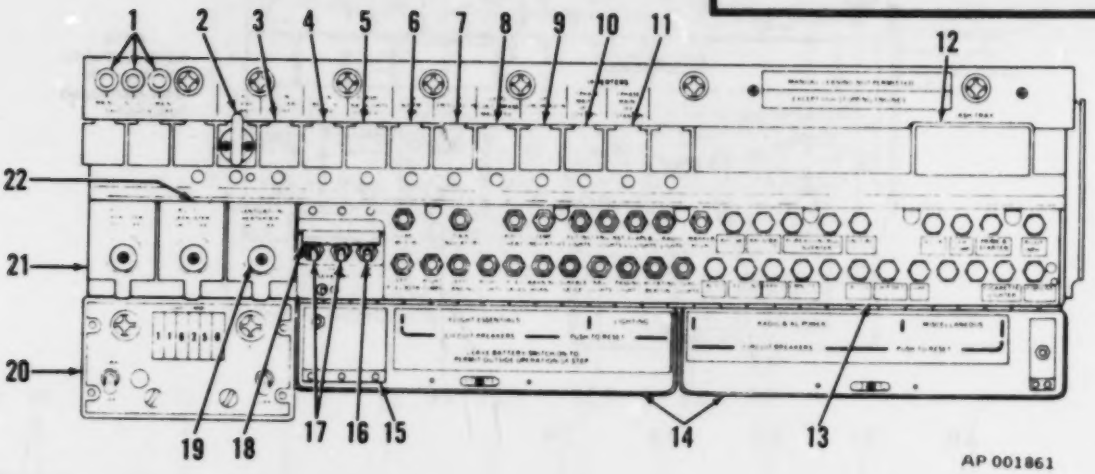


22. Passing (taxi) light switch
23. Pitot heat switch
24. Wing flap lock switch
25. Wing flap switch
26. Front seat cold air control
27. Propeller anti-icer rheostat
28. Compass correction card
29. Heater blower control
30. Landing gear handle
31. Rotating beacon switch
32. Interphone switch
33. Gyro compass slaving switch
34. One-phase inverter switch
35. Battery master switch
36. Ventilation heater air shutoff handle
37. Copilot's defroster control handle

Figure 2-11. Subpanels U-8D *(Typical) (sheet 2 of 2)*

NOTE

U-8D LEFT SUBPANEL TYPICAL FOR U-8G AIRCRAFT



1. Landing gear position indicator lights
2. Landing gear handle
3. Surface deicer switch
4. Rotating beacon switch
5. Navigation lights switch
6. Interphone switch
7. FM squelch switch
8. Gyro compass slaving switch
9. Attitude indicator switch
10. Inverter switch (one phase)
11. Inverter switch (three phase)
12. Ash tray
13. Circuit breaker panel
14. Right subpanel doors
15. Guard
16. Battery master switch
17. Generator master switches
18. Master switch gang bar
19. Ventilation heater air shutoff handle
20. VHF radio control panel
21. Pilot's defroster control handle
22. Copilot's defroster control handle

Figure 2-12. Right Subpanel U-8G

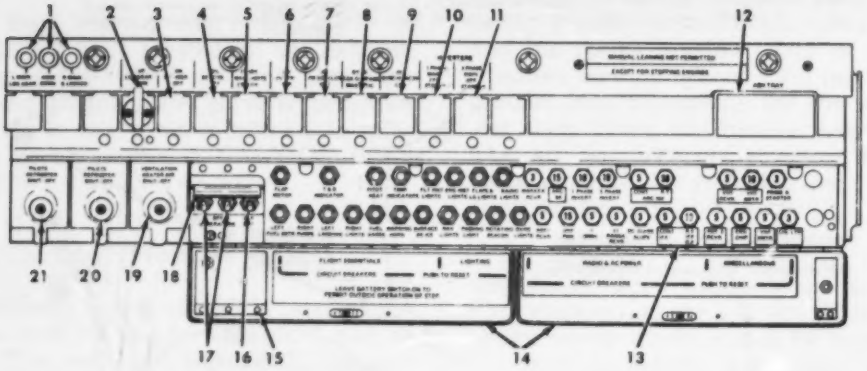
Normal entrance to the aircraft is through the main entrance door on the forward right side of the fuselage (figure 2-15). The entrance door and the two center windows provide emergency escape routes from the aircraft either on the ground or when ditching. On the RU-8D only the right center exit window may be used for emergency exit. The door may be jettisoned for bailout. Escape from the rear seat through the entrance door requires tilting of the right front seat, which is normally locked in position when the door is closed. Opening the door releases the seat lock; however, when the door is jettisoned, the lock must be released from the rear seat by pulling the emergency seat release handle at the back of the right front seat, near the floor. Refer to Chapter 9 for emergency exit procedures.

a. Entrance Doors. The entrance door (figure 2-15) is located on the right side of the fuselage and is opened from the outside by the conventional type door handle. To close the door from the inside, the door is pulled closed with the arm rest and locked by pushing the inside handle

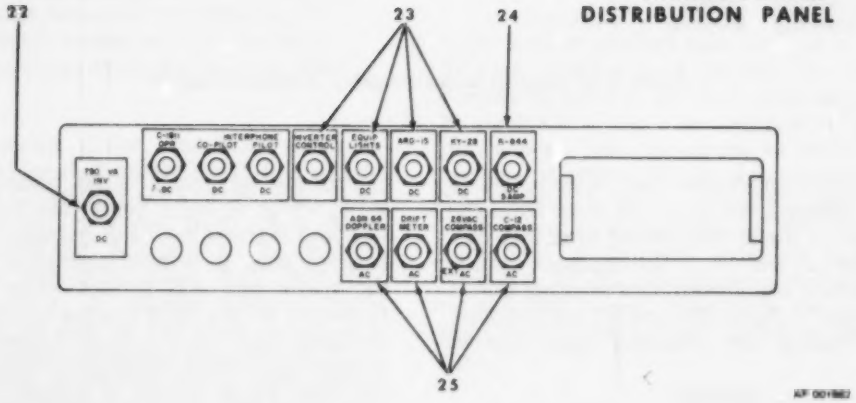
NOTE

U-8D LEFT SUBPANEL TYPICAL FOR RU-8D AIRCRAFT

RIGHT SUBPANEL



OVERHEAD POWER DISTRIBUTION PANEL



1. Landing gear position indicator lights
2. Landing gear handle
3. Surface deicer switch
4. Rotating beacon switch
5. Navigation lights switch
6. Interphone switch
7. FM squelch switch
8. Gyro compass slaving switch
9. Attitude indicator switch
10. Inverter switch (one phase)
11. Inverter switch (three phase)
12. Ash tray
13. Circuit breaker panel
14. Right subpanel doors
15. Guard
16. Battery master switch
17. Generator master switches
18. Master switch gang bar
19. Ventilation heater air shutoff handle
20. Copilot's defroster control handle
21. Pilot's defroster control handle
22. Inverter DC circuit breaker
23. DC circuit breakers
24. Marker beacon/glideslope fuse
25. AC circuit breakers

Figure 2-13. Right Subpanel and Overhead Power Distribution Panel RU-8D

CAUTION

CONTINUED OPERATION OF THE HANDLE AFTER A DOWN INDICATION IS NOTED ON THE LANDING GEAR POSITION INDICATORS WILL RESULT IN DAMAGE TO THE EMERGENCY EXTENSION MECHANISM. DO NOT ATTEMPT MANUAL RETRACTION OF THE LANDING GEAR WITH THE EMERGENCY EXTENSION SYSTEM.

1. LANDING GEAR CLUTCH LEVER
2. LANDING GEAR EMERGENCY EXTENSION HANDLE

NOTE

APPROXIMATELY 150 COMPLETE FORE-AND-AFT CYCLES OF THE HANDLE ARE REQUIRED TO LOWER AND LOCK THE LANDING GEAR.

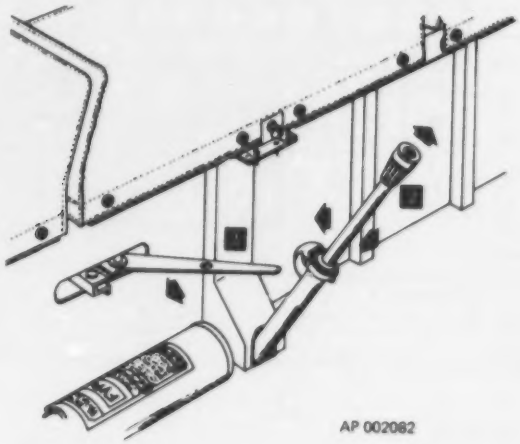


Figure 2-14. Landing Gear Emergency Extension Handle

forward until the spring-loaded lock, located above the handle, is engaged. To open the door from the inside, push up on the spring-loaded lock and pull the door handle out and aft. If the entrance door is not properly closed and locked, it is possible that it could come open in flight. Procedures for properly closing and locking the entrance door are as follows:

(1) Make sure inside handle is in the fully unlocked position (full out and aft).

(2) Using the left hand, grasp the armrest, pull the door closed and while holding firmly with left hand, push inside handle forward until it is engaged with the spring loaded hook latch.

(3) Check that door is securely locked at top and bottom.

NOTE

Cabin doors of U-8D, U-8D ASAC, and RU-8D are not air tight. Loss of maps, charts, or loose papers may occur if suction is present.

b. Cabin Entrance Step. U-8D Access to the cabin is provided by a retractable stair-type, electrically operated cabin entrance step (figure 2-15) which extends below the right inboard wing flap and retracts into the fuselage beneath the rear baggage area. In normal operation the step is fully automatic and will retract when fuel pressure is furnished to the right engine by either the main or auxiliary fuel boost pumps; likewise, the step will extend only when the right engine is stopped and the fuel boost pump is turned off. To prevent extension of the step in flight if the right engine is shutdown, the extension circuit is routed through the landing gear safety switch. The right main strut must be compressed by the weight of the aircraft before the step will extend. Should the situation arise which requires a single-engine landing with the right engine inoperative, the STEP MOTOR circuit breaker on the right subpanel should be pulled. Pulling the circuit breaker will prevent the step from extending during the landing roll after the aircraft weight is placed on the landing gear.

c. Cabin Entrance Step Selector Switch. U-8D The cabin entrance step selector switch (figure 2-15) located on the right side of the fuselage just aft of the rear baggage area, is accessible on the ground only. Inserting the battery lock switch key and turning clockwise, energizes the step circuit and extends the step. The step

motor is operated by power furnished by the aircraft DC electrical system, and is protected by a 15-ampere STEP MOTOR circuit breaker on the right subpanel (figure 2-11).

d. Cabin Step Warning Light. U-8D A cabin step warning light located on the extreme upper left side of the instrument panel above the airspeed indicator (figure 2-25), glows amber when the cabin step is in any position other than fully retracted. The light is placarded: CAUTION, STEP DOWN, DO NOT TAXI OR TAKE OFF.

2-11. Entrance and Exit Provisions. U-8G

Normal entrance to the aircraft is through the main entrance door on the forward right side of the fuselage. The entrance doors and two rear windows provide emergency escape routes from the aircraft either on the ground or when ditching. Refer to Chapter 9 for emergency exit procedures.

WARNING

The center side windows should never be opened in flight. Under no circumstances should a bailout be attempted through the windows.

a. Cabin Entrance Door. The cabin entrance door (figure 2-16) located on the right side of the cabin just behind the trailing edge of the wing, may be opened, closed and/or locked from either inside or outside of the aircraft. Entrance to the cabin is implemented by stair-type steps built into the cabin entrance door. A plastic covered cable mounted on the aft side of the door serves as a hand assist for personnel and to support the door in the open position. A latching safety chain which fastens to a hook inside the cabin just above the door supplements the door latching system.

b. Cabin Door Warning Light. As an added safety precaution, a press-to-test cabin door warning light placarded DOOR WARNING, is located on the upper left side of the instrument panel (figure 2-26). Illumination of the warning light indicates that the cabin entrance door is not closed and locked. The circuit is protected b; a 5-ampere, circuit breaker located on the right subpanel.

2-12. Windows.

WARNING

The center windows should never be opened in flight. Under no circumstances should a bailout be attempted through the windows.

a. U-8D RU-8D Visibility is provided by a windshield, two windows on each side of the aft cabin, a large window in the cabin entrance door, and the pilot's window. Two of the center side windows may be opened (one on RU-8D), on the ground only, by pushing the window handle latch and then lifting the window handle up and out. The aft windows are shielded by drapery-type curtains which are extended and contracted along fixed curtain rods.

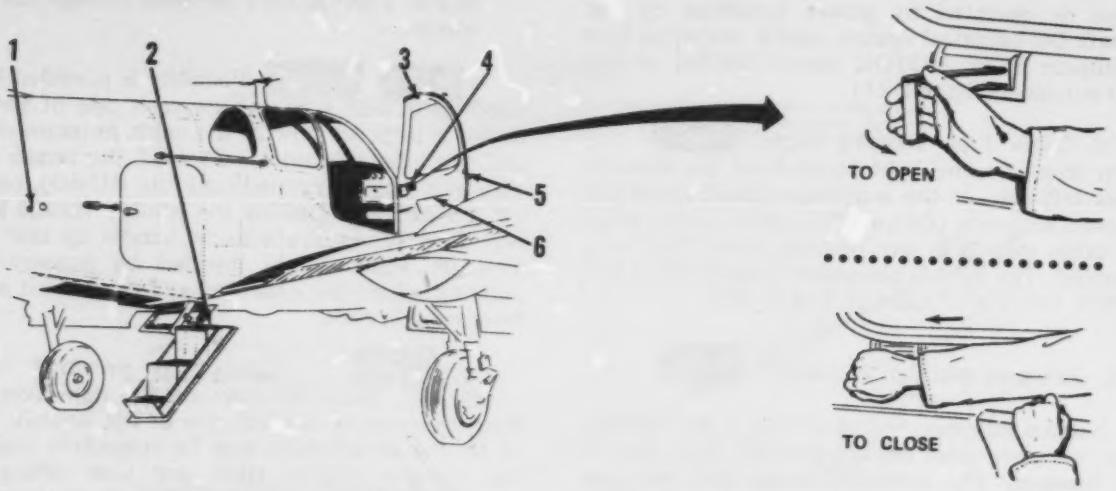
b. U-8G Visibility is provided by a windshield, three windows on the right side and four windows on the left side of the aircraft. Two of the center windows may be opened by pushing the window handle latch and then lifting the window handle up and out. The aft windows are shielded by drapery-type curtains which are extended and contracted along fixed curtain rods.

2-13. Seats.

a. Description. U-8D RU-8D The cabin front seat is divided into two parts (figure 2-17). The left portion seats the pilot on the left and the copilot in the center. It is adjustable fore and aft by means of a crank located below the front of the pilot's seat. The hinged backs permit freedom of movement when the shoulder harnesses are used. The pilot's and copilot's shoulder harness incorporate automatic inertial reels to allow for the additional movement required to operate the controls. RU-8D aircraft are equipped with a single mission equipment operator's seat located on the right side of the aircraft in the mission equipment area.

b. Description. U-8G The cabin is provided with individually adjustable seats for the pilot copilot, and passengers. Entrance to any seat is from the center aisle of the aircraft. The pilot's and copilot's seats are adjustable fore and aft by controls below the forward edge of each seat. The passenger seats may be reclined or released for fore and aft movement by control levers beneath each seat. Ash trays are incorporated in the inboard arm rest of each seat.

c. Seat Belts and Shoulder Harness. All seats are equipped with a seat belt and with the exception of the equipment opeator's seat, a shoulder harness. Each passenger has an over the shoulder type combination safety belt and shoulder harness which is attached to the airframe structure and when properly adjusted allows limited movement. The pilot's and copilot's shoulder harness incorporate an automatic inertia



1. Cabin entrance step selector switch
2. Cabin entrance step
3. Upper door latch
4. Cabin door inside latch handle
5. Cabin door outside latch handle
6. Arm rest and door pull handle

NOTE

THE CABIN ENTRANCE STEP INSTALLATION HAS BEEN REMOVED ON RU-8D AIRCRAFT DUE TO MAXIMUM GROSS WEIGHT LIMITATIONS.

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Figure 2-15. Cabin Entrance Door and Step U-8D RU-8D

shoulder harness incorporate an automatic inertia reel to allow for additional movement required to operate the controls. When anticipating a crash landing or ditching, locking of the shoulder harness provides an added safety precaution over that of the automatic lock. Depending on the cabin configuration, certain controls and switches may become inaccessible with the harness locked.

d. Inertia Reels. The inertial reel control is located on the left forward edge of each seat. When the handle is unlocked (aft), the inertia reel maintains a slight tension on the harness, but permits the pilot or copilot to lean forward to reach the controls. When the handle is moved to the locked (forward) position, the inertia reel locks the harness in successive positions as the pilot leans back. Before the inertia reel can be unlocked, all tension must be removed from the harness by leaning full back in the seat. If the handle is in the unlocked (aft) position, an impact force of 2 "G"s will automatically lock the inertia reel and prevent the occupant from being thrown forwards To unlock after a 2 "G" impact, move the handle to the locked (forward) position and then to the unlocked (aft) position. When anticipating a crash landing or ditching, locking the shoulder harness provides an added safety precaution over that of the automatic lock. Depending upon individual seat adjustment, certain control and switches may become inaccessible with the harness locked. Each pilot and copilot should determine for himself to what extend a locked shoulder harness would interfere with aircraft and systems control.

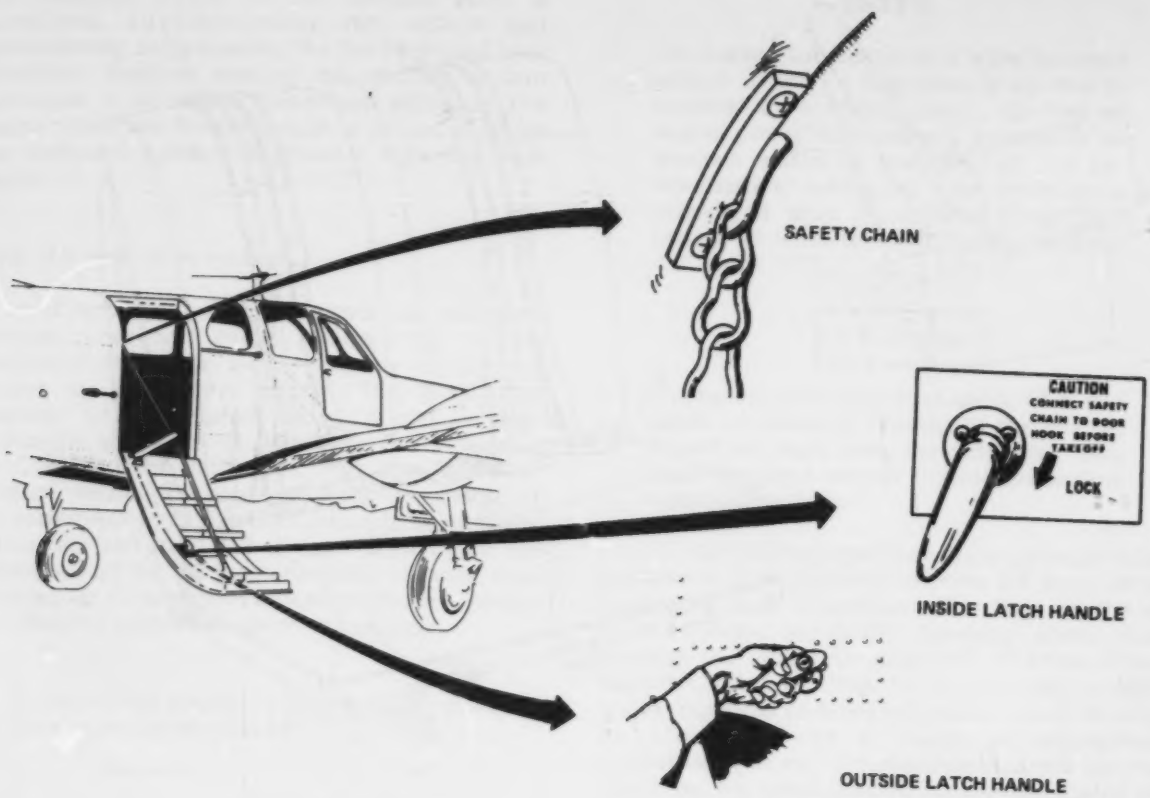


Figure 2-16. Entrance Door and Step U-8G

Section II. EMERGENCY EQUIPMENT

2-14. Description.

The equipment covered in this section includes all emergency equipment, except that which forms a part of a complete system. For example, landing gear system, etc. For the operation of emergency exits and for the location of all emergency equipment, refer to Chapter 9.

2-15. Hand-Operated Fire Extinguisher.

WARNING

Repeated or prolonged exposure to high concentrations of monobromotrifluoromethane (CF3Br) or decomposition products should be avoided. The liquid should not be allowed to come into contact with the skin, as it may cause frost bite or low temperature burn because of its low boiling point.

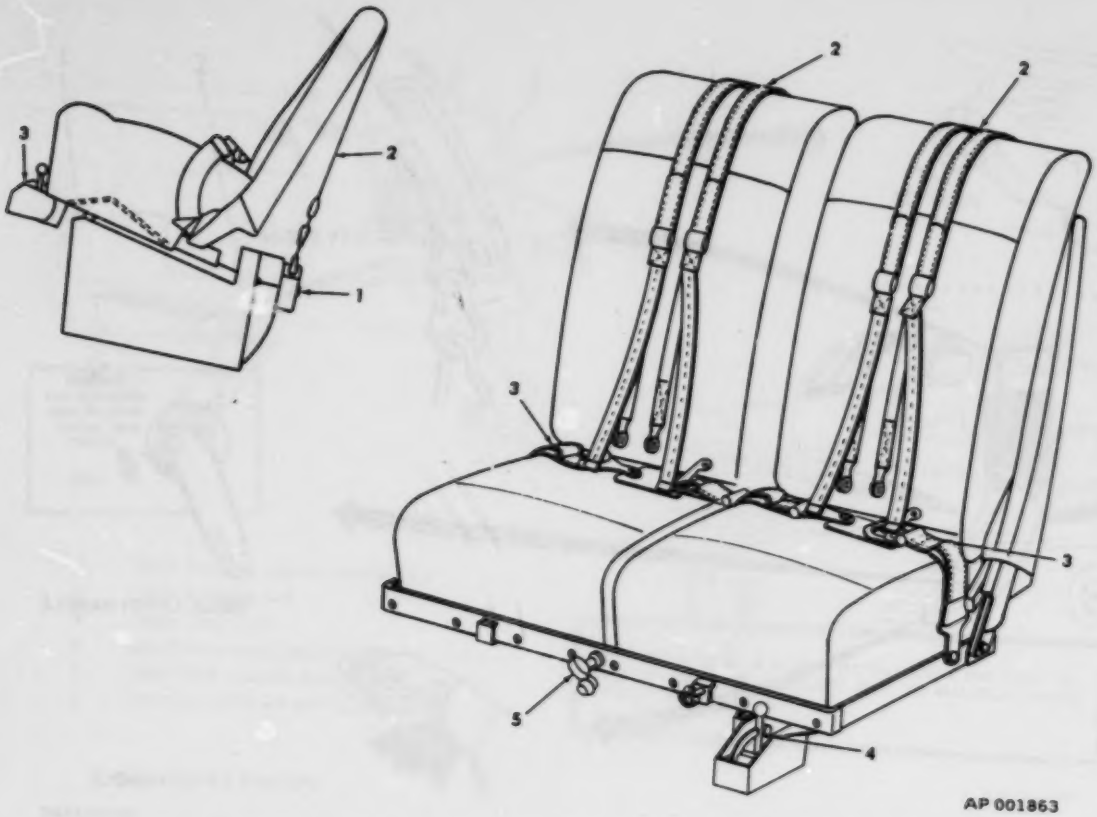
A hand-operated monobromotrifluoromethane (CF3Br) fire extinguisher is mounted on the forward side of the main spar just below the front passenger seat. The installation is protected by a plastic cover. Release the latch on the retaining strap to remove. The emitted stream is under a pressure of 150 to 175 PSI.

NOTE

Engine fire extinguisher systems are not installed.

2-16. First Aid Kits.

There are two first aid kits secured to the right fuselage wall with snap fasteners, one underneath the instrument panel and the otwer forward of the aft baggage area.



1. Inertia reel
2. Shoulder harness
3. Seat belt
4. Inertia reel control
5. Seat adjustment control lever

Figure 2-17. Pilot and Copilot Seats (Typical)

Section III. ENGINES AND RELATED SYSTEMS

2-17. Description

Two Model 0-480-1, dry sump, super-charged, air-cooled, six-cylinder, horizontally opposed engines are used for aircraft power. The engines utilize augmentor tube exhaust systems for improved cooling. The engines also utilize pressure-type carburetors. The supercharger is a noncontrollable, gear driven, mechanical, single-stage, centrifugal type and is located on the accessory housing on the rear of the engine.

2-18. Engine Cooling System.

Engine cooling is provided by airflow induced through two engine exhaust augmentor tubes at the rear of each engine nacelle. The augmentor-type exhaust system employs the velocity and pumping action of the exhaust gases being ejected into the augmentor tube throat, from each bank of cylinders, to induce airflow through the engine nacelles and to vary the flow of cooling air around the engine. As engine RPM is increased,

the pumping action of the exhaust gases is increased, supplementing ram airflow and automatically compensating for the additional heat generated; thereby, making the cooking system automatic at all engine speeds and altitudes. The engine crankcase breather tube is routed through the outboard exhaust augmentor tube for each engine.

2-19. Air Induction System.

a. Description. The carburetor air induction system prevents engine failure due to the carburetor air intake duct becoming blocked by impact ice or foreign matter. The installation consists of two spring-loaded doors in each carburetor air intake duct between the carburetor air filter and the carburetor heat box. When air pressure within the engine nacelle, or outside of the carburetor air intake duct, exceeds the pressure within the air duct, the spring-loaded doors are forced inward by the greater outside pressure, thus allowing air to be drawn into the induction system and allowing engine operation to continue.

b. Operating Practices. The operating practices for this system are as follows:

(1) Under conditions of visible moisture, it is possible to form induction ice in the induction manifold system between the carburetor and the compressor inlet. Elbow induction icing pertains to ice accumulations that form on the aft inside surface of the 90 degree elbow located directly aft of the carburetor. Accumulated ice at this point may not be detected by a loss in manifold pressure, usually associated with induction system icing, because of the large cross sectional area of the elbow. But the rate of ice buildup at takeoff power may cause engine coughing and momentary roughness. Elbow icing is more pronounced at higher power settings, particularly in climb power. Timely use of carburetor heat will prevent engine power loss due to carburetor and induction system icing. When it is known that flight operations are to be in temperature range of -10° to +15°C, apply carburetor heat as required to maintain 55° to 60°C carburetor air temperature. Application of carburetor heat will cause a slight manifold pressure reduction. After applying carburetor heat, if a slow rise in manifold pressure is noted, ice is present and is melting. Monitor the manifold pressure and cylinder head temperature closely during this period. If the heat capacity is sufficient and if remedial action has not been delayed, the elimination of ice will require only a matter of seconds.

NOTE

Use carburetor heat before icing becomes critical. If the ice formation is allowed to progress to a critical point, the loss of engine power may make it impossible to generate sufficient heat to melt the ice. Atmosphere containing free moisture is considered most favorable for induction system ice when temperatures are between -10° and +15°C.

CAUTION

The use of carburetor heat above 74°C can result in material damage to the engine. Therefore, when using the carburetor heat, make frequent checks to avoid exceeding temperature limits.

(2) During operation under probable icing conditions, it is possible to form ice from moist impact air. This formation will collect on the air inlet filters, eventually blocking them, thus opening the automatic alternate air doors. When complete filter blockage is encountered, a slight loss in manifold pressure will result which can only be eliminated by a change in atmospheric conditions. The use of carburetor heat will have no effect on ice accumulation on the carburetor air inlet filter. Refer to Chapter 8 for carburetor heat adjustment procedure just prior to, during, and immediately following the takeoff, and during the initial climb.

NOTE

Operation in the region below 49°C is recommended for normal operation. Rough engine operation is an indication of icing conditions. Apply sufficient carburetor heat for stable operation.

2-20. Carburetor.

Carburetion is furnished by a single-barrel type carburetor equipped with an automatic altitude mixture control unit and an airflow power enrichment valve, in addition to a regulated-pressure discharge nozzle, idle cut-off mechanism, and a single-diaphragm, vacuum-operated accelerating pump. The automatic altitude mixture control unit provides the proper fuel-air ratio at all altitudes. Carburetor and induction system icing conditions are minimized through system design and operation.

a. Throttles. Dual throttles located in the center of the control column console (figure 2-20), control manifold pressure. Either throttle may be operated independently for single-engine operation; OPEN (forward) and CLOSED (aft). Retarding the throttles to a position corresponding to 16 inches Hg. manifold pressure will cause the landing gear warning horn to sound when any landing gear is not down and locked, thereby indicating an unsafe condition for landing.

CAUTION

During icing conditions, apply carburetor heat as required to maintain +55° to +60° C temperature.

b. Carburetor Heat Control Handles. The carburetor heat control handles (figure 2-7) are located on the left subpanel just below the flap position indicator lights. Pulling the handles out operates the carburetor alternate air valves in each carburetor duct system by restricting the flow of normal ram air from the nacelle air scoops and furnishes heated air from muffs around the exhaust stacks for carburetor heat. Positioning the handles in any intermediate position between full in and full out provides a mixture of warm and normal ram air.

CAUTION

The mixture levers must be set to the RICH position under all operating conditions. Manual leaning is not permitted. The mixture levers may be moved from the RICH position only when stopping the corresponding engine.

c. Mixture Levers. Two mixture levers are located on the control column console to the right of the throttles (figure 2-20). Each lever has two positions; RICH (forward) and idle cutoff (aft). At the idle cutoff position, all fuel flow except priming fuel is shut off from the engines. The RICH position, through the automatic mixture control unit, provides the proper fuel mixture for all ground and flight operations.

d. Friction Lock Knob. A friction lock knob is located on the left side of the control column console below the propeller levers (figure 2-20). Rotation of the friction lock knob clockwise increases friction and prevents creeping of the throttle, mixture, and propeller levers; counterclockwise rotation decreases friction and allows free movement of the levers.

e. Operating Practices. The operating practices for this system are as follows:

(1) To increase power: First, increase engine speed (RPM) by moving the propeller levers forward. Second, increase manifold pressure by increasing the throttle setting.

(2) To decrease power: First, reduce manifold pressure by reducing the throttle setting. Second, decrease engine speed (RPM) by moving the propeller levers aft.

(3) If descent requires a large reduction in power, reduce the RPM as well as the manifold pressure. For descents or other low power maneuvers, or for a simulated engine failure, it is important to cushion the high inertia loads on the rod bearings which occur at conditions of high RPM and low manifold pressure. As a general rule each 100 RPM requires at least 1 inch Hg. manifold pressure; for example, 24 inches Hg. manifold pressure at 2400 RPM. Operation above 2750 RPM with low manifold pressure should be kept to a minimum.

(4) Detuning the engine, or throwing the engine crankshaft vibration dampeners out of phase with the crankshaft, must be avoided. This condition may be breated either by a sudden closing of the throttle, or by operating the engine under a high RPM and low manifold pressure power setting (2800 rpm or higher, and under 15 inches Hg). Either of these actions may cause the crankshaft vibration dampeners to leave their normal position at the outer periphery of their respective races in the crankshaft counterweight and shuttle violently around the races. Such an event not only causes noticeable momentary roughness of engine operation, but may result in incipient engine damage that could cause engine failure, necessitating an engine change. For sudden engine power cutoff, such as the simulation of engine failure, use the idle cutoff switch or mixture control lever. Leave the throttle in the normal open position until the engine has slowed down due to lack of fuel. With the throttle open, air is allowed to fill the cylinders, thereby creating normal compression forces capable of cushioning engine deceleration.

(5) Correct operation of the mixture levers is very important to engine life. They must always be left in the RICH position (full forward) during normal engine operation. Manual leaning is not permitted. For normal engine shutdown, retard the throttle slowly to the desired engine RPM then move the mixture lever to the idle cutoff (aft) position.

(6) Spark plug fouling is a major cause of ignition trouble and one of the most common aircraft engine maintenance and operating problems. Fouling may be defined as an accumulation of deposits which cause misfiring or prevents firing across the spark plug electrodes. The most common types of fouling are lead fouling and carbon fouling, with lead fouling the most predominant. In general, fouling involves a buildup of deposits through prolonged operation under a fixed set of conditions. Prevention and remedy for plug fouling, therefore, depend on taking action to vary these conditions, or upset the chemistry of the fouling cycle, and restore good ignition. Tetraethyl lead is the basic cause of lead fouling. During the fuel combustion process in a cylinder, this lead will condense out of the fuel onto the spark plug insulators as lead oxide or lead bromide compounds, in the presence of excess carbon which will form it into metallic lead particles. All such deposits can prevent ignition (misfiring). Carbon fouling is usually due to prolonged ground running at idle, particularly when the idle mixture is richer than best power. Excess carbon from the rich mixture plus engine oil in combustion tend to buildup as fouling deposits. A symptom of such fouling is indicated by excessive RPM drop during the magneto check. In some instances where plug fouling has occured, the difficulty was not apparent at any stage of the engine procedure. It is generally more practical to prevent spark plug fouling than to attempt to remove fouling deposits. A spark plug change is often the only satisfactory remedy.

2-21. Engine Primer System.

a. Description. Priming of the engines for starting is accomplished by the injection of raw fuel under boost pump pressure into each cylinder. The priming system consists of an electric solenoid priming valve, a primer distributor, and spring-loaded pushbutton primer switches which control operation of the primer solenoids for the respective engine.

b. Primer Buttons. Two primer buttons, spring-loaded to off, are located on the engine switch panel between the magneto switches and starter buttons. The buttons are placarded L and R corresponding to the left and right engines. Pressing the PRIMER button for either engine opens the electrically operated solenoid valve and permits discharge of raw fuel into all cylinders, providing the booster pump for that respective engine is in operation. A nose compartment door safety switch, actuated by the nose compartment door latch, opens the primer circuits for both engines when the door is unlocked, preventing the engines from being primed. The priming system operated from power furnished by the aircraft DC electrical system is protected by the PRIME & STARTER 5-ampere circuit breaker located on the right subpanel (figure 2-11 2-12 or 2-13).

2-22. Oil Supply System.

a. Description. Lubrication for the engines is supplied by a dry sump, full pressure lubrication system incorporating an engine-driven circulating pump, oil tank, and oil cooler for each engine. The oil tanks separately mounted behind the firewall in each nacelle have a capacity of 4.0 US gallons each and are serviced through an access door on top of the nacelle. A pressure relief type oil tank filler cap is installed to relieve normal engine crankcase pressures in the event of breather line restriction. To assure adequate cooling of the engine oil, a thermostatically controlled oil cooler is used. For cold weather starts, a thermostat controlled bypass valve in the oil cooler allows the oil to bypass the cooler unit until proper operating temperatures are obtained. No oil dilution provisions are installed.

b. Oil Shutoff Handles. To provide an emergency means of oil supply shutoff from the oil tank to the engine, an oil shutoff valve is installed between the oil tank and firewall for each engine. Each oil shutoff valve is manually operated by a red T-shaped handle located on the cabin floorboards. Pulling the handle full out closes the oil shutoff valve. Rotating the handle counterclockwise, after it has been pulled full out, locks it in the closed position. To open the oil shutoff valve, turn the handle clockwise and push down.

NOTE

After closing the engine shutoff valves and repositioning the handles to the open position, check visually that the valves have fully opened.

2-23. Engine Ignition System.

Engine ignition is provided by a dual magneto installation on each engine. An impulse coupling, incorporated into the left magneto on each engine, is actuated mechanically at the low crankshaft speeds encountered during engine starting, to provide a hotter retarded starting spark. As engine speed increases, the coupling is disengaged by centrifugal force, resulting in a normally advanced spark. The right magneto does not include this coupling and is not used during engine starting.

The shielded ignition wiring is so arranged that the left magneto fires the top plugs in the left cylinders and the bottom plugs of the right cylinders, while the right magneto fires the bottom plugs of the left cylinders and the top plugs of the right cylinders.

a. Engine Switch Panel. U-8D The engine switch panel located on the upper left side of the instrument panel (figure 2-25), contains the BATTERY lock switch, two pairs of magneto switches (left and right switches for each engine), and a starter and primer button for each engine.

b. Engine Switch Panel. RU-8D U-8G U-8D ASAC The engine switch panel (figure 2-5, 2-6 or 2-7) is a single cased unit mounted on the cabin side wall just below the pilot's storm window. The unit contains the BATTERY ON-OFF lock switch, two pairs of magneto switches (left and right switches for each engine), and a starter and primer button for each engine.

c. Magneto Switches. Magneto operation is controlled by two pairs of magneto switches on the engine switch panel (figure 2-25). Each set of switches placarded LEFT and RIGHT, control the magnetos of the left and right engines respectively. Individual switches in each pair, placarded L and R, provide individual magneto control for the respective engine. During engine shut-down, when all magneto switches are off, turning the BATTERY lock switch to OFF will automatically lock the magneto switches in the off position. With the magneto switches in the on position, the BATTERY lock switch is locked in the ON position. This prevents inadvertent cut-out of the magentos by turning the battery lock switch OFF. For engine starting, only the L magneto switch is placed in the on position. After the engine is firing, the R magneto switch is turned on.

2-24. Engine Starter.

The engines are cranked by direct-drive electric starters, operating from the aircraft DC electrical system. The starters engage automatically when energized, and disengage when de-energized. Two starter buttons, spring-loaded to off, are located at the top of the engine switch panel above the primer switches. The starter buttons are placarded START L and R corresponding to the left and right engines, and are pressed to energize the starters. The starter switch circuit is routed through the nose compartment door safety switch to prevent engine starting unless the door is closed and locked.

2-25. Engine Instruments.

Indications of engine performance or condition are provided by the multi-purpose dual engine instruments grouped across the upper center section of the instrument panel. All instrument markings indicate operating range and operating limits (figure 2-25, 2-26, or 2-27). Refer to Chapter 5 for instrument markings.

a. Manifold Pressure Gage. Manifold pressure obtained at the intake manifold on both engines is transmitted to the dual manifold pressure gage (figure 2-25, 2-26, or 2-27) located along the top of the instrument panel adjacent to the tachometer. The gage is a direct-reading pressure instrument, indicating manifold pressure in inches-of-mercury.

b. Tachometer. Engine speeds are indicated in hundreds of revolutions per minute (RPM) on the dual, electric tachometer which is located at the top of the instrument panel adjacent to the manifold pressure gage (figure 2-25, 2-26 or 2-27). The tachometer is energized by an engine-driven tachometer generator installed on each engine and operates independently of the aircraft AC or DC electrical systems.

c. Engine Gage Units. An engine gage unit for each engine (figure 2-25, 2-26 or 2-27) located on top of the instrument panel adjacent to the manifold pressure gage indicates fuel and oil pressure in pounds per square inch (PSI) as obtained through direct pressure lines from the engine to the indicator. Oil temperature is detected by an electrical resistance type temperature bulb operating from the aircraft electrical system and is indicated on each engine gage unit in degrees celsius. The oil temperature indicator circuit is protected by a circuit breaker placarded TEMP INDICATORS, on the right subpanel.

d. Cylinder Head Temperature Gage. Cylinder head temperature is indicated in degress celsius on the dual cylinder head temperature gage located below the manifold pressure gage unit in the U-8D (figure 2-25) and the U-8G (figure 2-26) and adjacent to the carburetor air temperature gage in the RU-8D (figure 2-27). Operation of the gage is provided by the aircraft DC electrical system. The flow of direct current is varied by a resistance-type temperature bulb installed at the number five cylinder of each engine. The electrical circuit is protected against overloads by a circuit breaker, placarded TEMP INDICATORS, on the right subpanel.

e. Carburetor Air Temperature Gage. Air entering the carburetor before it is mixed with fuel is registered in degrees celsius by the dual carburetor air temperature gage located adjacent to the right engine gage unit on the upper right hand side of the instrument panel (figure 2-25, 2-26 or 2-27). Carburetor air temperature is detected by a resistance-type temperature bulb in the carburetor and transmitted electrically to the indicator. Power for operation of the gage is furnished by the aircraft DC electrical system. The circuit is protected by a 3-ampere circuit breaker, placarded TEMP INDICATORS, on the right subpanel.

f. Engine Chip Detector Warning Lights. Two amber press-to-test engine chip detector warning lights are located at the top of the instrument panel directly above the engine gage units (figure 2-25, 2-26 or 2-27). The warning lights are marked L-ENG. CHIP DET. - R, WARNING LIGHT, and are wired to a chip detector installed in the left and right engine oil scavenge pump screen. When a large metal chip or sufficient smaller particles bridge the electrically insulated air gap between the magnet and body of the chip detector, the electrical circuit is completed and the engine chip detector warning light comes on. The circuit is protected by a circuit breaker on the right subpanel placarded CHIP DET.

Section IV. FUEL SYSTEM

2-26. Fuel Supply System.

a. Description. Engine fuel is supplied by two independent fuel systems. The fuel system has a total capacity of 230 US gallons in lightweight, bladder-type fuel cells. Each system consists of one main and three interconnected, bladder-type auxiliary fuel tanks (figure 2-18) with provision for crossfeed from the main tanks only, which may be operated to supply either engine individually or both engines simultaneously. Each engine has its own individual fuel system. Each fuel system is equipped with a pressure-type carburetor, engine-driven fuel pump, tank selector valve, and electrically operated submerged fuel boost pumps, located in each main tank and each of the rear-inboard auxiliary tanks. Fuel for each engine is pumped from the respective fuel tank by the engine-driven fuel pump through the tank selector valve to the carburetor. The submerged fuel boost pumps, operating from the aircraft DC electrical system, serve as an auxiliary source of fuel pressure for starting, takeoff, landing and in the event of engine fuel pump failure. The engine-driven fuel pumps and submerged boost pumps operate together or separately to supply fuel at the correct pressure and quantity to the carburetor. Through the use of the crossfeed system, the fuel in the main tanks may be used to supply either engine. There are no provisions for crossfeed of the auxiliary fuel.

b. Fuel Tank Selector Valve Handles. Two fuel tank selector valve handles placarded CARB are located on the fuel system control panel (figure 2-19) on the left side of the cabin. The handle is mechanically linked to the fuel selector valve on the aft side of the engine firewall. The valve can be opened to the MAIN, AUX or CROSSFEED ports, or closed to all by selecting the corresponding handle position.

NOTE

When changing the position of the fuel selector handle make sure the handle is properly positioned by the click-and-feel method rather than exact alignment, to avoid placing the valve in a partially opened position.

c. Fuel Boost Pumps. Fuel pressure for starting and priming is provided by electric fuel boost pumps which are submerged in each main tank and in each of the rear inboard auxiliary cells. The engine-driven pump and the submerged fuel boost pumps operate together or separately to supply fuel at the correct pressure and quantity to the engine. A tank selector valve and system strainer are provided as a single unit for each engine and are located behind the firewall. The electric priming system is provided with fuel by the boost pumps. All fuel system controls and quantity gages are located on the fuel system control panel.

d. Boost Pump Switches. Two boost pump switches on the fuel system control panel (figure 2-19) control the submerged boost pumps, which operate from the aircraft DC electrical system. Two 10-ampere circuit breakers on the right subpanel, placarded LEFT, RIGHT, FUEL BSTR PUMPS, protect the circuits.

e. Fuel Quantity Gages. The fuel quantity gages on the fuel system control panel (figure 2-19) are placarded AUX 71 GAL and MAIN 44 GAL.

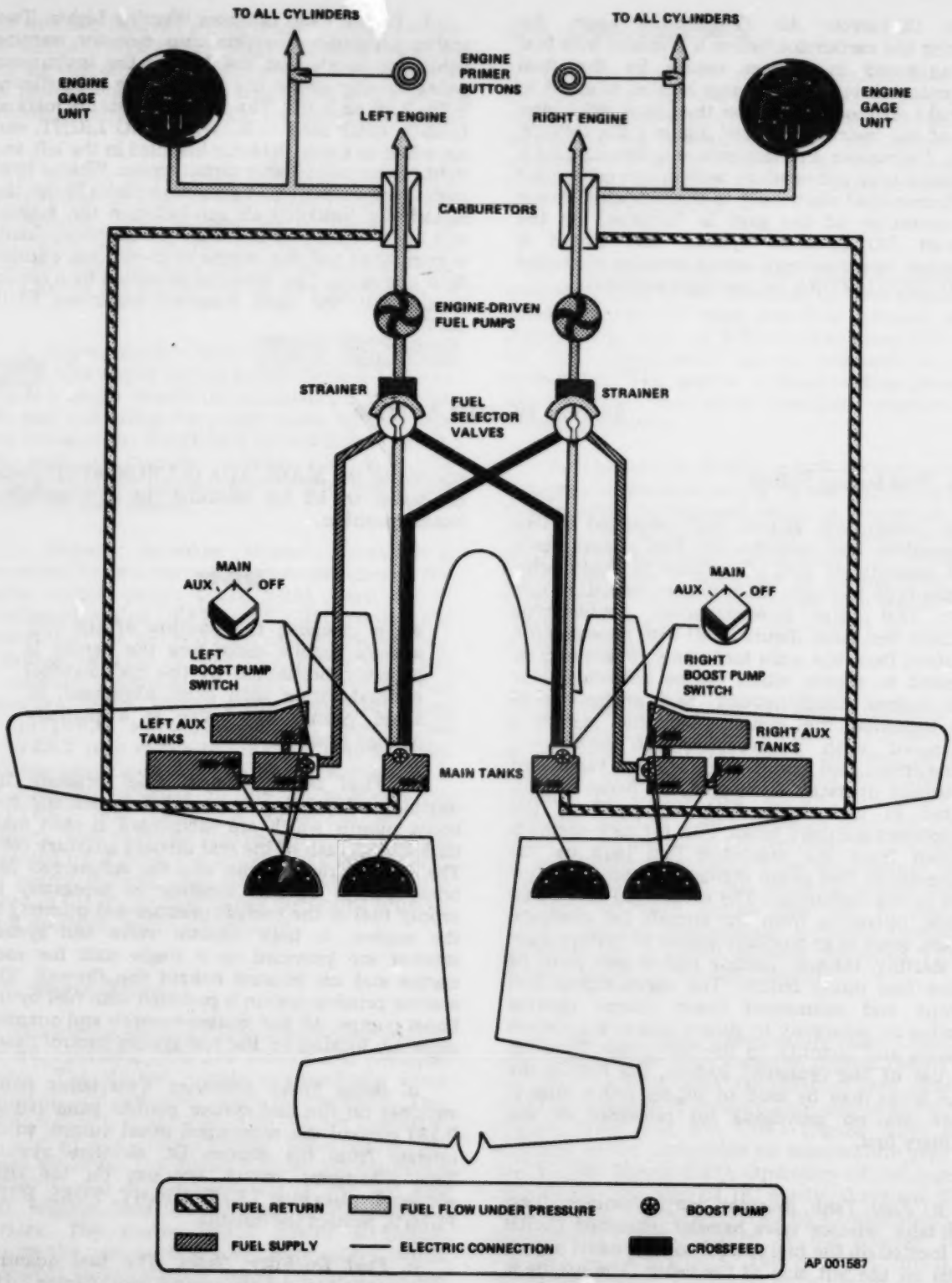
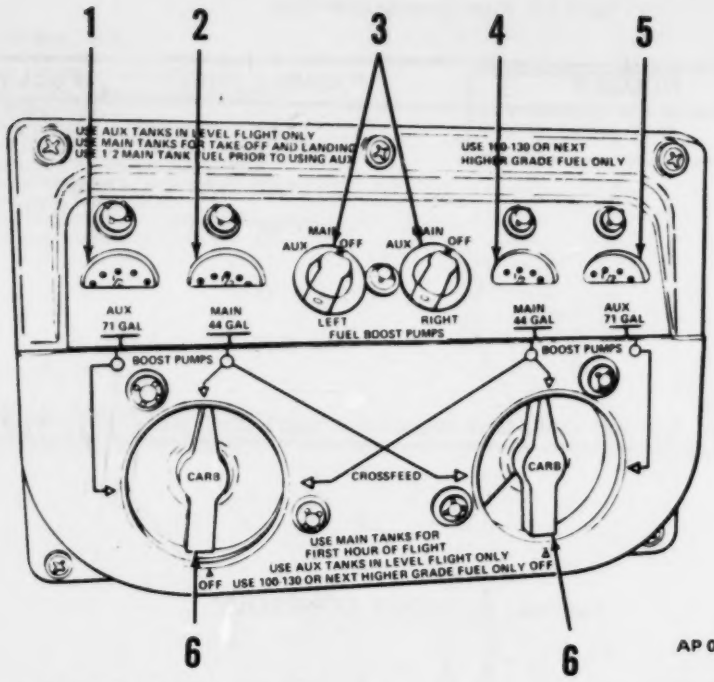


Figure 2-18. Fuel Supply System (Typical)



AP 001599

1. Left auxiliary fuel quantity gage
2. Left main fuel quantity gage
3. Boost pump switches
4. Right main fuel quantity gage
5. Right auxiliary fuel quantity gage
6. Fuel tank selector valve handles

Figure 2-19. Fuel System Control Panel (Typical)

The gages respond to signals from transmitters in the fuel tanks operating on the aircraft DC electrical system. The circuit is protected by a 10-ampere FUEL GAGES circuit breaker on the right subpanel.

2-27. Fuel Management.

The fuel used during warmup, taxiing, takeoff and landing should be supplied from each engine's main tank. The fuel supply for the engines during the first part of the flight should be consumed from the main tanks so that sufficient space will be available for the fuel (3 gallons per hour) returned to each engine's main tank via the fuel return system. After sufficient space has been made available in the main tanks for the computed return fuel, the fuel supply for the engines should be changed from the main to the auxiliary tanks.

For flights of short duration or flights not requiring full fuel load, fill the main tanks first and put the remaining fuel in the auxiliary tanks. This will allow greater flexibility in passenger seating and the loading of baggage and cargo.

NOTE

When changing the position of the fuel selector handle make sure the handles are properly positioned by the click-and-feel method rather than exact alignment, to avoid placing the valves in a partially opened position.

2-28. Approved Fuels.

The aircraft uses 100/130 as it's primary fuel and 115/145 as it's alternate.

Table 2-2. Fuel Quantity Data Table

TANK	NUMBER	*USABLE FUEL	FULLY SERVICED
Left Main	1	44	44
Right Main	1	44	44
Left Auxiliary	3	71	71
Right Auxiliary	3	71	71
Total Usable Fuel		230	230

*Total usable fuel and listed tank capacity is based on level flight attitude.

Section V. FLIGHT CONTROLS

2-29. Description.

All flight control surfaces (ailerons, rudder, and elevator) are conventionally operated through cable and pulley arrangement by wheel and rudder pedal controls. Mechanically controlled trim tabs are incorporated in the rudder, elevators, and left aileron.

2-30. Control Column. U-8D RU-8D

The "throwover" control column (figure 2-20) may be rotated 180 degrees around the longitudinal axis to the center front seat position. A spring-loaded lock holds the control arm in any of four positions as desired, providing adjustment to two heights at each flight station. Pulling out on the lock handle permits the arm to be rotated free, and releasing the handle locks the arm in place as it reaches the desired position. The dual T type control column has two control wheels instead of the throwover control arm. A microphone switch (button) is provided in each control wheel.

2-31. Control Column. U-8G

The dual T type control column (figure 2-6) provides control of the aircraft by either the pilot or copilot from a fixed position. Each control wheel is provided with a microphone switch (button).

2-32. Flight Controls Lock.

Positive locking of the rudder, elevator, and aileron control surfaces, and throttles in the closed position is provided by a removeable lock (figure 2-20) which may be attached to the control column. The basic locking function is performed by a pin which is inserted through a guide hole in the control column console and into concentric holes in the control colum and aileron shaft within the column, thus locking the column and the control wheel. Locking of the rudder is accomplished by raising the rudder lock from its stowed position on the floor, positioning the rudder pedals to fit between the notches provided on each side of the lock, and then attaching the bungee cord, which is attached from the controls lock, to the hook provided on the end of the rudder lock. The body of the controls lock is attached to the throttles, locking them in the closed position with an overcenter type fastner. The controls lock is stowed in the map case during flight.

2-33. Rudder Pedals.

Control of rudder, nosewheel steering, and braking with toe pressure is provided by the rudder pedals from either the pilot's or copilot's position. A fore-and-aft position of the rudder pedals is provided by means of a spring-loaded adjustment lever at each pedal. Pushing the adjustment lever

TO REMOVE CONTROL LOCK:

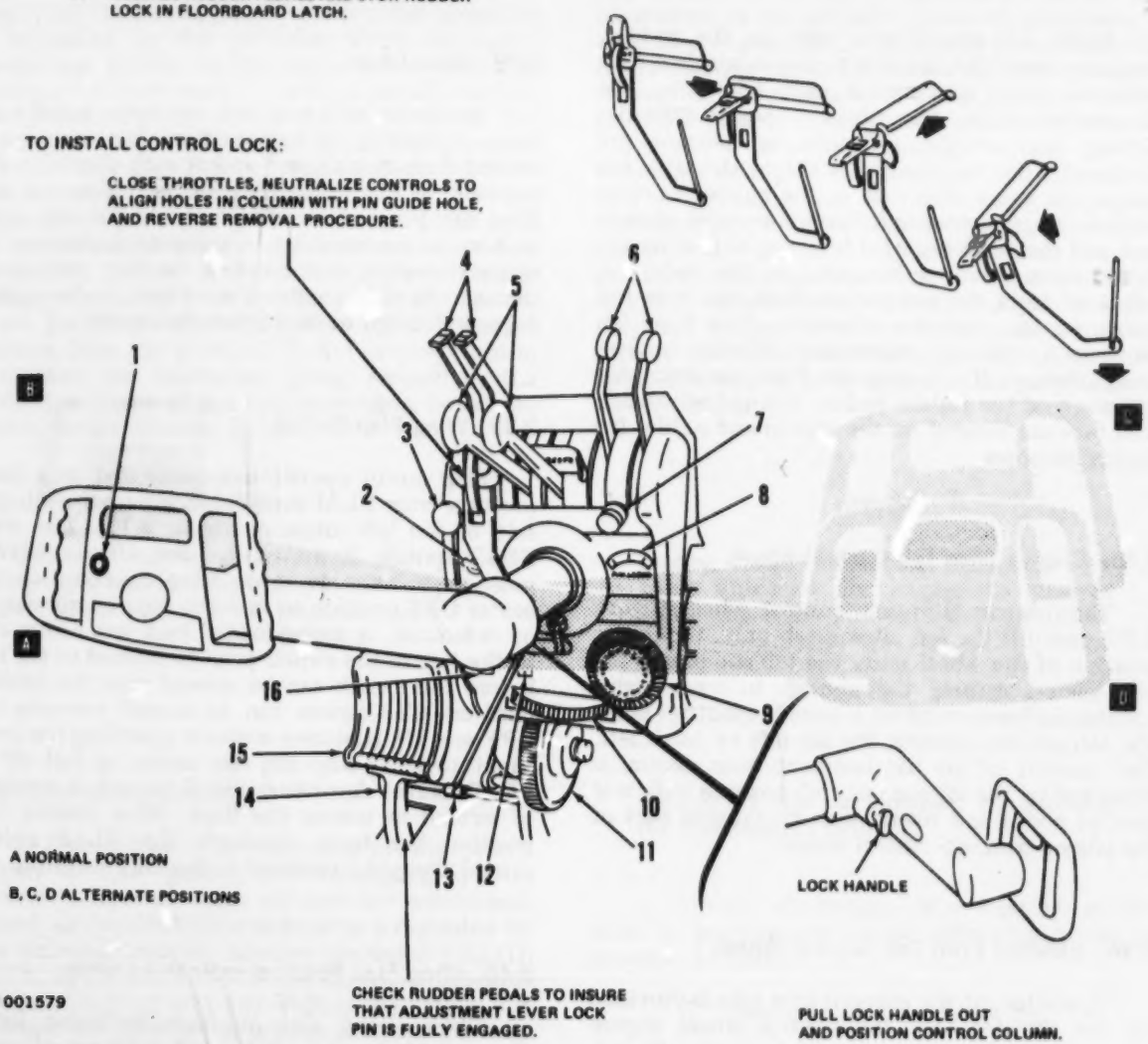
A. LOCK IN ENGAGED POSITION.
B. ROTATE LATCH DOWN, DISENGAGE HOOK FROM THROTTLE PLATE.
C. LIFT PLATE CLEAR OF THROTTLES.
D. ROTATE LOCK TO LEFT AND PULL PIN OUT OF CONTROL COLUMN AND GUIDE HOLE.
E. DISCONNECT CONTROL LOCK BUNGEE CORD FROM RUDDER PEDAL LOCK.
F. RELEASE RUDDER PEDALS AND STOW RUDDER LOCK IN FLOORBOARD LATCH.

NOTE

U-8G AIRCRAFT ARE EQUIPPED WITH A DUAL CONTROL COLUMN INSTALLATION

TO INSTALL CONTROL LOCK:

CLOSE THROTTLES, NEUTRALIZE CONTROLS TO ALIGN HOLES IN COLUMN WITH PIN GUIDE HOLE, AND REVERSE REMOVAL PROCEDURE.



1. Microphone button
2. Cabin temperature rheostat
3. Friction lock knob
4. Propeller control levers
5. Throttles
6. Mixture levers
7. Cigarette lighter
8. Aileron trim tab position indicator
9. Aileron trim tab control wheel
10. Rudder trim tab control wheel
11. Elevator trim tab control wheel
12. Rudder trim tab position indicator
13. Rudder lock
14. Rudder pedal adjustment lever
15. Rudder pedal
16. Elevator trim tab position indicator

Figure 2-20. Control Pedestal and Locks (Typical)

in, towards the pedal, releases the lock pin permitting adjustment of the pedal to desired fore or aft position; releasing the lever locks the pedal in the selected position. Lever lock pin engagement prevents collapse and damage to the arm and possible loss of brake operation.

2-34. Trim Tabs.

Flight adjustable trim tabs on the rudder, elevators, and left aileron are cable controlled by a jackscrew type actuator at each trim tab. The elevator and aileron trim tabs incorporate antiservo action; i.e., as the elevators or ailerons are displaced from the neutral position, the trim tab moves the same direction as the applied control surface, thus increasing effective control surface area and the force required to apply it. Rudder tab incorporates servo action; i.e., as the rudder is displaced from the neutral position, the trim tab moves in the opposite direction. This trim tab movement, although decreasing effective rudder area, substantially lightens the force necessary for operation of the rudder pedals. Ground adjustable trim tabs are located on the aileron and rudder for rigging purposes.

2-35. Aileron Trim Tab Control Wheel.

The aileron trim tab control wheel (figure 2-20) controls the left aileron tab only. Clockwise rotation of the wheel raises the tab and lowers the left aileron causing the aircraft to bank right; counterclockwise rotation lowers the tab and raises the left aileron causing the aircraft to bank left. The amount of tab displacement from neutral is indicated by the aileron trim tab position indicator located above and operates as an integral part of the aileron trim tab control wheel.

2-36. Elevator Trim Tab Control Wheel.

Operation of the elevator trim tabs is provided by the elevator trim tab control wheel (figure 2-20). Forward rotation of the wheel raises the tab and lowers the nose of the aircraft; aft rotation lowers the tab and raises the nose. The amount of tab deflection is indicated in degrees on the elevator trim tab position indicator.

2-37. Rudder Trim Tab Control Wheel.

The rudder trim tab operation is controlled by the rudder trim tab control wheel (figure 2-20). Rotation of the trim tab control wheel to the right deflects the tab left yawing the nose right; rotation of the wheel left, deflects the tab to the right yawing the nose left. The amount of tab deflection from neutral is indicated on the rudder trim tab position indicator, located directly above and operates as an integral part of the rudder trim tab control wheel.

2-38. Wing Flaps.

The electrically actuated, slot-type, metal wing flaps, consisting of two sections for each wing, extend from the inboard end of each aileron to the junction of the wing and fuselage. Although the flaps are lowered or raised as a single unit, each section is actuated by a separate jackscrew. A single reversible motor drives the four jackscrews through flexible shafts. Flap travel is from zero degrees (full up) to 30 degrees (full down).

2-39. Wing Flap Switch.

Flap motor operation is controlled by a three position wing FLAP switch located on the inboard side of the left subpanel (figure 2-11). The wing FLAP switch is moved to the UP or DOWN position to raise or lower wing flaps and to the center OFF position to stop the flaps at any degree of extension. A spring-loaded lock just below and to the left of the switch must be pushed to the left before the switch can be moved into the DOWN position. The switch can be moved between the OFF and UP positions without operating the lock. Limit switches stop the flap motor at full UP or DOWN travel. Approximately 6 seconds is required to extend or retract the flaps. After desired flap position has been obtained, the FLAP switch should always be returned to the OFF position.

2-40. Wing Flap Position Indicator Lights.

Three wing flap position indicator lights (figure 2-11) located on the left subpanel adjacent to the wing FLAP switch, operate from the aircraft DC power system and are provided to indicate UP, DOWN and intermediate flap positions as follows: flaps UP, green light; flaps DOWN 30° amber light; flaps DOWN 20° blue light. The blue light provides a reference for stopping flap travel at 20 degrees and goes out when this position is passed. A 3-ampere circuit breaker, placarded FLAPS, located on the right subpanel (figure 2-11, 2-12 or 2-13) protects the warning light circuit.

Section VI. PROPELLERS

2-41. Description.

Each engine is equipped with an all metal, three bladed, hydraulically operated, constant speed, full feathering propeller. Propeller operation is controlled by the propeller levers through a mechanical linkage to the engine-driven propeller governor on each engine. A setting introduced into the propeller, governed by the pilot, determines the engine speed to be maintained. The governor then controls the flow of engine oil boosted to high perssure by the governor pump to or from the propeller pitch control piston in the propeller hub. Oil pressure directed against the piston in each hub moves the piston forward and a pitch change linkage, connected between the piston and blades, twists the blades toward increase RPM. When oil pressure from the governor to the propeller piston is relieved, the feathering spring, assisted by the centrifugal force of the counterweights, twists the blades toward decrease RPM.

2-42. Propeller Control Levers.

Control of engine RPM and propeller feathering is provided by operation of the propeller control levers (figure 2-20) located adjacent to the throttle levers. Placing the propeller control levers full foward provides the highest engine RPM obtainable. A safety detent, installed near the aft end of the lever travel, provides a low RPM stop. Movement of the propeller levers aft progressively decreases engine RPM. Further movement of the levers through the detent into FEATHER position relieves all oil pressure from the governor to the propeller piston, allowing the blades to go into the FEATHER position through action of the feathering spring in the propeller hub assisted by centrifugal forces of the counterweights. Unfeathering the propellers is accomplished with oil pressure provided by the engines to the governor, unless accumulators are installed. If the engine is shutdown with a feathered propeller, the propeller control lever must be pushed forward through the detent and the engine started with the starter. As engine RPM increases, the propeller will slowly unfeather.

NOTE

During normal shutdown, high pitch stop pins automatically engage to prevent feathering below approximately 800 RPM.

Section VII. UTILITY SYSTEMS

2-43. Defrosting System.

a. Description. The defrosting system, which is part of the heating and ventilating system, provides a flow of warm air over the windshield. Heated air for windshield defrosting is regulated by two defroster control handles placarded PILOTS DEFROSTER SHUT OFF on the right subpanel (figure 2-11, 2-12 or 2-13). Pulling the handle out increases the flow of air a proportionate amount. When pulled all the way out, the defroster air is full on.

NOTE

Should normal cabin temperature prove insufficient for adequate windshield defrosting, rotate the cabin temperature rheostat to full WARM and open one or more cold air outlets to regulate cabin temperature. Airflow to the pilots windshield can be increased by shutting off the copilot's defroster.

b. Normal Operation. The heating system must be in operation for the defrosting system to function properly.

1. Heating system — Operating.
2. Defroster controls — As required.

2-44. Surface Deicer System.

Ice accumulations on the leading edge of the wings, the horizontal stabilizers, and the vertical stabilizer are removed by the flexing action of seven inflatable pneumatic deicer boots. The timer is turned on and off by the surface DE-ICER switch on the right subpanel. A gage registers the pressure within the system.

WARNING

A rippling or loose deicer boot is a flight hazard which may cause failure of the surrounding skin or structure. If a rippling or looseness of the deicer boot is observed when the deicing system is not operating an entry shall be made in DA Form 2408-13 and the condition corrected before the next flight.

a. Controls and Pressure Gage. Operating pressure for the deicer system is registered on the DE-ICING pressure gage located on the upper right side of the instrument panel (figure 2-25, 2-26 or 2-27). The gage registers pressure within the system in pounds per square inch (PSI). Control of the deicer system is maintained by a two-position DE-ICER switch on the right subpanel (figure 2-11, 2-12 or 2-13). When this switch is placed in the ON position, the DC circuit to the electronic timer-operated distributor valves is completed, thus, pressurized air from the engine driven vacuum system is pumped through the pressure regulating system to the individual deicer boots. A maximum pressure of 17 PSI inflates the boots which crack and remove any accumulated ice. Air is then discharged out of the boots until the pressure reaches approximately 1 in. Hg. The operating cycle then retracts the boots which are ported to the inlet side of the vacuum system by the distributor valves and the remaining air is evacuated from the boot. When the deicing system is not operating, suction is applied by the distributor valves to hold the boots down. The distributor valves, which control the flow of air to and from the respective deicer boots, are controlled by the electronic timer located in the nose compartment. The deicer circuit is protected from an overload by a 10-ampere SURFACE DE-ICE circuit breaker on the right subpanel (figure 2-11, 2-12 or 2-13).

NOTE

Normal deicer system operation will be available under all conditions up to 20,000 feet with both engines operating, and up to 10,000 feet under single-engine operation.

b. Normal Operation. Place the surface DEICER switch in the ON position to energize the electronic timer and actuate the system. From this point, operation is automatic. The timer is regulated to fully inflate and deflate both passages within each boot once every 60 seconds until the system is turned off.

2-45. Propeller Anti-icing System.

a. Description. Ice accumulation on the propeller blades is prevented by the use of the liquid type anti-icing system. Fluid for the system is stored in a 3-gallon reservoir which is located in the left inboard wing. Fluid quantity of the anti-icing reservoir is indicated by the propeller anti-icer fluid gage located on the right side of the instrument panel, placarded PROP ANTI-ICE FLUID (figure 2-25, 2-26 or 2-27). A regulated supply of anti-icer fluid is routed through a filter, to the anti-icer pump, through check valves, to the propeller slinger rings and to the propeller blades. A rheostat on the left subpanel, placarded PROP ANTI-ICE, provides control of the speed of the anti-icer pump and thus the duration of fluid supply.

NOTE

The propeller anti-icing system is designed to prevent the accumulation of ice, not to remove ice after it has formed. Abnormal icing conditions may appreciably decrease the duration of fluid supply.

b. Normal Operation. To operate the system, rotate the rheostat knob clockwise to the maximum position to actuate the pump. Wait several seconds to insure the pump has started and stabilized; then back off to the desired setting. The lowest setting provides a minimum rate of flow and a maximum duration of approximately 3.5 hours.

2-46. Pitot and Stall Warning Heat System.

a. Description. The pitot head has an electric heater element to prevent the formation of ice in or over the pitot tube opening. Ice formation on the pitot tube can obstruct the impact air entering the pitot tube, resulting in an erroneous reading at the airspeed indicator. The stall warning switch, triggered by a small metal vane, is located on the leading edge of the left outboard wing. The switch and vane installation is also electrically heated to prevent accumulation of ice. False warnings or an inoperative switch may result from accumulation of ice on the switch. Power for operation of the heating elements is furnished by the DC electrical system. A 5-ampere PITOT HEAT circuit breaker on the right subpanel (figure 2-11, 2-12 or 2-13) protects the circuit.

CAUTION

The electric heating elements should never be placed in operation while the aircraft is on the ground, except for a momentary check during the before exterior check. Overheating, due to a lack of cooling airflow, will seriously damage the heating elements.

b. Normal Operation. The electric heating circuit for both units is controlled by the PITOT HEAT ON-OFF switch on the left subpanel (figure 2-11). When the pitot heat switch is placed in ON position, fluctuation of the voltammeter needle does not necessarily indicate that both heating units are operating. See paragraph 8-12 for a reliable method of checking proper operation of the systems.

2-47. Oxygen System. U 8D

a. Description. The aircraft incorporates an oxygen supply system (figure 2-21) to permit flight operations at altitudes where atmosphere oxygen is insufficient for safe operation. The pilot and copilot are provided with a rebreather oxygen mask while disposable masks are provided for other personnel. The oxygen control console is located overhead, slightly aft, and to the left of the pilot's seat. Microphones for voice communication are installed in the pilot's and copilot's masks. The system is designed to deliver approximately 95 percent of the cylinder capacity. The duration of oxygen supply is given in Table 2-3. A manual control regulator, located in the oxygen control console, when adjusted to match the altimeter reading, provides an optimum oxygen flow to all outlets. A system shutoff valve is also located on the oxygen console. A pressure gage registers system pressure in pounds per square inch. This gage indicates the duration of the oxygen supply when considered in conjunction with the number of persons using the system. The supply regulator is calibrated in thousands of feet of altitude to correspond with the altimeter on the instrument panel. When properly adjusted with the altimeter, the regulator gage maintains the proper mixture of oxygen and air as long as the aircraft remains at the set altitude or until the oxygen supply is exhausted. The five individual outlets may be used individually or simultaneously. Each outlet incorporates a valve which opens as the plug-in coupling is inserted.

b. Normal Operation. To operate the system, the cylinder shutoff valve must be open. The cylinder is clamped to the aft baggage area bulkhead. Opening the console shutoff valve allows flow to the regulator and distribution outlets. For the proper mixture of air to oxygen, turn the regulator knob until the gage corresponds to the altimeter. Disconnect the lip microphone lead from the headset and connect it to the oxygen mask plug-in. Proceed as follows:

CAUTION

Open the cylinder shutoff valve very slowly, particularly the first turn, then open fully.

CAUTION

To prevent damage to the regulator diaphram, the gage should always be set to "0" altitude before the console shutoff valve is turned on.

1. Set the regulator to "0".

2. Place the console shutoff valve in the full open position.

3. Turn regulator until gage corresponds with altimeter.

WARNING

Pure oxygen will support combustion. Make certain that no smoking or open flame is in the area before using the system.

4. Plug in masks and check to insure that the red warning in flow indicator disappears when the mask is plugged in. If there is no flow of oxygen to the mask, a red warning indicator appears in the flow indicator.

NOTE

A loss of oxygen will occur if the valves are open and a mask is connected without being used.

NOTE

The outside temperature is reduced as the aircraft ascends to higher altitudes. The oxygen cylinder, thus cooled by the temperature change, will show a drop in pressure. This drop in oxygen pressure is occasionally a cause for unnecessary alarm. Upon return to a lower or warmer altitude, a rise in the oxygen pressure should occur. A valid cause for alarm would be rapid loss of oxygen pressure when the aircraft is in level flight or descending.

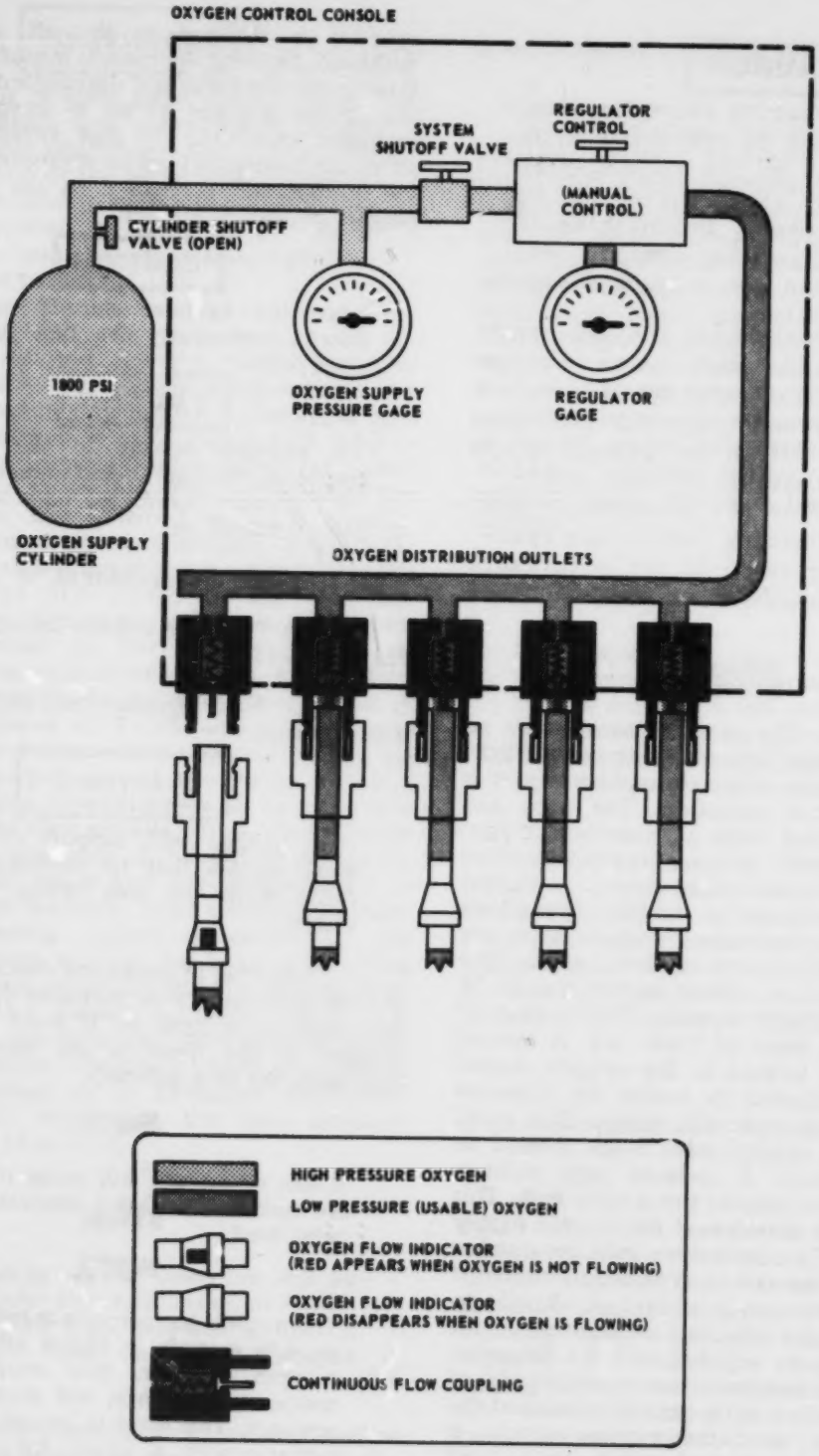


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Figure 2-21. Oxygen System U-8D U-8D ASAC

2-48. Oxygen System U 8G

a. Description. The oxygen system (figure 2-22) supplies breathing oxygen to all personnel through plug-in mask outlets from an oxygen supply cylinder located beneath the aft baggage area floor and charged to 1800 PSI. The oxygen is distributed to the oxygen distribution outlets at a rate which has been determined as sufficient for the average person while at rest. The duration of the oxygen supply (Table 2-3) is proportional to the number of persons using the system and cruising altitude of the aircraft. The oxygen system supply is indicated by a pressure gage located on the aft baggage area bulkhead. This gage also indicates the pressure when the system is being charged through the filler valve located on the frame just aft of the cabin entrance door. The oxygen automatic pressure regulator, mounted to the frame just aft of the cabin entrance door reduces the pressure when the oxygen cyclinder shutoff valve is open. The regulator automatically adjusts the flow of oxygen to the six fixed outlet valve metering orfices regardless of altitude or number of personnel receiving oxygen. The six outlet valves are protected by spring-loaded caps to prevent dirt from entering when the outlet is not in use. Plugging an oxygen mask hose coupling into a valve opens that valve and permits oxygen flow to the mask. The valve closes again when the oxygen mask hose coupling is disconnected. Since the oxygen requirements of the pilot and copilot are greater while flying than the passenger's requirements at rest, larger orfices are installed in the pilot's and copilot's outlets.

WARNING

Pure oxygen will support combustion. Make certain that no smoking or open flame is in the area before using the system.

CAUTION

Open the supply cylinder shutoff valve very slowly, particularly the first turn, then open fully.

b. Normal Operation. The oxygen system is completely automatic after the cylinder shutoff valve is turned on at the supply cylinder and the system shutoff valve is turned on at the frame just aft of the cabin entrance door. The only control operation required is plugging the masks into the outlets. The system contains no flow indicators. To check the flow, pinch off the opening from the breather bag to the mask. The flow of oxygen entering the bag will cause it to expand.

NOTE

The outside temperature is reduced as the aircraft ascends to higher altitudes. The oxygen cylinder, thus cooled by the temperature change, will show a drop in pressure. This drop in oxygen pressure is occasionally a cause for unnecessary alarm. Upon return to a lower or warmer altitude, a rise in the oxygen pressure should occur. A valid cause for alarm would be the rapid loss of oxygen pressure when the aircraft is in level flight or descending.

2-49. Stall Warning System.

Approach of a stall is indicated by a stall warning horn located behind the instrument panel which emits a steady tone. A small metal vane, located on the left outboard wing leading edge, is moved by the change in airflow at the leading edge when the airspeed drops within 5 knots of stalling speed. Movement of the vane actuates a switch completing the DC electrical circuit to the horn. Since the vane is affected by the same aerodynamic forces that result in the stall the system functions regardless of the type of stall or configuration of landing gear and wing flaps, with the only variation in performance being the margin of airspeed at which the warning occurs. To prevent ice formation on the stall warning vane an electrically operated heating element is installed which operates from the same circuit as the pitot heat.

NOTE

An intermittently sounding horn, also located behind the instrument panel, is used to indicate landing gear position.

2-50. Vacuum System.

A vacuum pump on each engine provides suction for operation of the copilot's attitude indicator and surface deicer system. Check valves in the lines from each pump permit continued operation of the attitude indicator and deicer system in the event one pump fails or one engine is inoperative. A suction gage on the instrument panel indicates vacuum system suction in

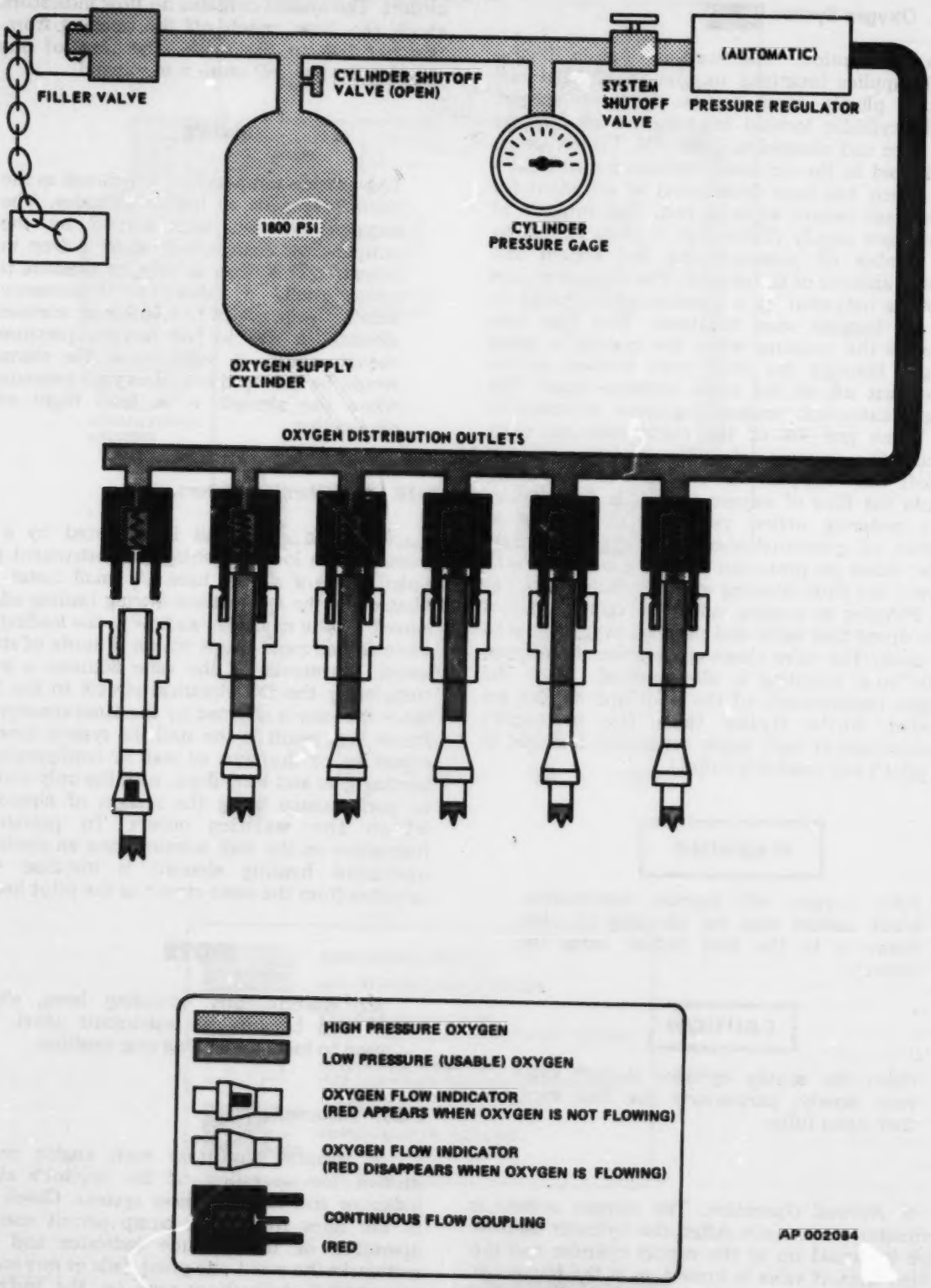


Figure 2-22. Oxygen System U 8G

Table 2-3. Oxygen Duration Chart

	PERSONS USING	DURATION IN HOURS AT FOLLOWING ALTITUDES 8000	10000	15000	20000	25000
U-8D	1	17.7	14.4	9.4	7.1	5.7
	2	8.9	7.2	4.7	3.6	2.9
	3	5.9	4.8	3.1	2.4	1.9
	4	4.4	3.6	2.4	1.8	1.4
	5	3.5	2.9	1.9	1.4	1.1

	PERSONS USING	DURATION IN HOURS AT FOLLOWING ALTITUDES 10000	15000	20000	25000
U-8G	1	11.4	10.5	9.7	8.9
	2	5.6	5.3	4.8	4.4
	3	4.3	4.0	3.6	3.3
	4	3.5	3.2	2.9	2.6
	5	2.9	2.6	2.4	2.2
	6	2.5	2.3	2.1	1.8

Note: Oxygen system has been removed from RU-8D.

inches-of-mercury (in. Hg) (figure 2-25, 2-26 or 2-27). The suction gage is a direct reading instrument and is calibrated in increments from 0 to 10 IN OF HG. A suction gage selector knob (figure 2-11) located on the left subpanel has three placarded positions: LEFT PUMP CHECK, INSTR NORMAL, RIGHT PUMP CHECK. When the knob is placed in INSTR NORMAL, suction at the copilot's attitude indicator is indicated. Turning the knob to LEFT PUMP CHECK or RIGHT PUMP CHECK provides a reading of suction at the points indicated.

2-51. Seating Provisions.

a. U-8D The cabin (figure 2-4) normally accomodates four passengers, three in the rear and one in the right front haul seat. The center front (copilot) seat may also be used as a passenger seat. The right front seat is hinged at the lower front edge. The arrangement allows the seat to pivot forward to allow easy access to the rear seat when the door is open. The right front seat is locked in the normal position when the door is closed. Opening the door actuates a release permitting the seat to be titled. The rear seat has a hinged back that is adjustable fore-and-aft to change the angle of the seat. Each passenger seat is equipped with a seat belt-shoulder harness as a single unit.

b. U-8G The cabin (figure 2-6) accomodates four passengers with two rows of seats separated by a center aisle. Each seat may be moved fore-and-aft on a track arrangement by lifting the fittings on the forward legs of each seat. Ash trays are incorporated in the inboard arm rest of each passenger seat. Each seat is equippped with a seat belt.

c. Operator's Seat. RU-8D Passenger seating for the RU-8D has been replaced by a single mission equipment operator's seat located on the right side of the aircraft in the mission equipment

area (figure 2-7). This seat is equipped with a seat belt.

2-52. Cigarette Lighters and Ash Trays.

These are installed at various locations throughout the aircraft. The lighters are protected by a single circuit breaker placarded CIG LIGHTER located on the right subpanel.

2-53. Storage Pocket.

A pocket is located on the left sidewall just below the fuel system control panel for storage of flight publications.

2-54. Rear Seat Cold Air Seal.

An air seal installation along the bottom and sides of the rear seat back prevent the forward flow of cold air from the aft baggage area into the cabin. Zippers permit the separation of the seal along its full length so that the rear seatback may be removed for maintenance purposes or cargo space.

2-55. Relief Tubes.

Two relief tubes are installed - one adjacent to the pilot's station, and the other in the aft cabin.

Section VIII. HEATING, VENTILATION, COOLING, AND ENVIRONMENTAL CONTROL UNIT

2-56. Heating and Ventilating System.

a. Description.

(1) The combustion heater operates on engine fuel from the right main tank. Fuel consumption is approximately 2/3 gallon per hour.

(2) Air for both heater operation and circulation is supplied by either ram air or the heater blower. When the aircraft is airborne, ram air enters through an intake which surrounds the taxi light. During ground operation the blower provides required air for heater operation and circulation. When the aircraft becomes airborne and the landing gear handle is placed in the UP position, the blower will automatically shut off. When the landing gear handle is placed in the DOWN position the blower will again be turned on.

(3) A circuit breaker switch, placarded HEATER BLOWER, (figure 2-11) is installed on the left subpanel to operate and protect the heater and blower circuits. The switch must be turned ON before either the blower or heater will function.

(4) When the temperature in the warm air plenum reaches 200°F a temperature limiting switch in the warm air plenum breaks the circuit. When the temperature falls below 200° F the heater circuit is energized.

(5) Also installed in the warm air plenum is an overheat thermostat which will close at 300° F. The closing of this switch blows a 5-ampere fuse in the heater circuit. When this fuse blows the heater is inoperative. Replacement of this fuse cannot be accomplished while airborne.

(6) A constant cabin temperature ranging from 36° F to 85° F is maintained by adjusting the cabin rheostate on the control column console (figure 2-20). The OFF position shuts off the heater. The full warm position provides constant operation by cutting out the cabin thermostat. In the intermediate range the rheostat regulates a cabin temperature thermostat mounted on the cabin rear bulkhead. This thermostat regulates heater operation to maintain an even temperature.

(7) Pulling out the ventilation heater air shutoff control (figure 2-11, 2-12 or 2-13) on the right subpanel closes the shutoff valve in the intake plenum a proportionate amount. The control is linked to a switch so that closing the valve more than halfway shuts off the heater and blower circuits. In flight a reduced amount of cold air is then allowed to enter the cabin through the warm air outlets.

(8) Airflow from the cold air outlets on the instrument panel is controlled by the front seat cold air control on the left subpanel (figure 2-11). Pulling the control out increases the airflow. Cold air volume from the wall mounted outlets beside the seats is regulated by rotating the outlets. Moving the outlets in their speherical sockets changes the direction of airflow.

(9) Engine preheat for cold weather starts on the U-8D and U-8G aircraft is provided by the engine preheat system. The system uses two

collapsible flexible ducts to carry heated air from the warm air plenum to each nacelle. The ducts, permanently attached to the plenum, have quick disconnect fittings for attachment to the nacelles. When not in use the ducts are collapsed and stowed in the fuselage beside the heater plenum. The ends are then attached to blind plates to prevent the escape of hot air.

b. Normal Operation - Cabin Heat.

(1) Heater blower switch - ON.

(2) Ventilation heater air shutoff control - In.

(3) Cabin Temperature rheostat - As required.

c. Emergency Operation - Cabin Heat. Failure of the heater to operate or to cut off, caused by a malfunction of the cabin temperature thermostat, can be temporarily overcome by using the cabin temperature rheostat. Turn the rheostat to the full WARM position, which will turn on the heater, or to the OFF position, which will turn off the heater. The heater blower switch will also turn the heater on and off. If the fuel fails to ignite cut the safety wire on the igniter and pull the switch out. This switches to an alternate set of points. The action must be done on the ground since the igniter is inside the nose wheelwell. Replace the defective unit as soon as practicable. Should a malfunction cause the overheat thermostat to blow the 5-ampere heater fuse, pull out the ventilation heater air shutoff control and shut the heater off. The heater cannot be operated until the fuse is replaced on the ground.

CAUTION

The heater should not be operated after replacing the fuse until the entire system has been thoroughly checked for the cause of failure. The condition causing the fuse to blow is invariably the result of a malfunction; therefore, further operation of the heater could be dangerous.

NOTE

Should the heater fail to operate, pull out the ventilation heater air shutoff control to reduce the flow of cold air through the cabin.

d. Normal Operation - Ventilation System.

(1) Cabin temperature rheostat - OFF.

(2) Ventilation heater air shutoff valve - As required.

(3) Cabin cold air outlets - As required.

(4) Front seat cold air outlets - As required.

e. Normal Operation - Engine Preheat System. U-8D U-8G

(1) Open the preheat duct access door and withdraw the free ends of the preheat ducts.

(2) Plug a preheat duct into the preheat duct opening on the inboard side of each engine nacelle.

(3) Start the heater and turn the cabin rheostat to the highest setting.

NOTE

Use external power to operate the cabin heater for preheating. The batteries have insufficient capability to operate the heater over a prolonged period and still start the engines. Cabin windows and doors should be closed to prevent the escape of as much warm air as possible and force the maximum amount of heated air through the nacelles.

(4) Disconnect and stow the preheat ducts after the engine has started and is running smoothly.

Section IX. ELECTRICAL POWER SUPPLY AND DISTRIBUTION SYSTEM

2-57. Description.

The electrical power system consist of a 24-28 volt DC monitored bus system and an AC inverter system operated by DC power. The systems are a conventional single wire design with the aircraft structure forming the ground return for all circuits. In the event of complete generator failure, all electrically operated equipment will be operative directly from the batteries until battery power is exhausted.

CAUTION

Circuit breakers shall not be indiscriminately reset (recycled). Fuses, inaccessible in flight, shall not be indiscriminately replaced.

2-58. DC Power Supply System.

a. U 8D Direct current electrical power is supplied by a 24-28 volt DC system powered by two 300-ampere engine-driven generators which are connected in parallel to the main bus system. All equipment operating from the aircraft electrical system is DC except the glide slope, gyro magnetic compass and attitude indicator, which are operated from alternating current furnished by inverters located in the nose compartment. Two 12-volt storage batteries are connected in series to the main bus system through two relays, one in the positive lead and one in the negative lead for dual safety. This provides 24-volt direct current for starting and low engine RPM ground operation when no external power is available or when no generator output is obtained. An external power receptacle located on the outboard side of the left nacelle is connected directly to the aircraft bus system. This makes external DC electrical power available regardless of battery switch position. Generator control relays and voltage regulators are located in the generator control box on the aft bulkhead of the nose compartment under the right subpanel, and are accessible during flight. The generator control system includes paralleling circuits to equalize the load borne by each generator. All circuits except the starter relays are protected by circuit breakers. Figure 2-11 shows the circuit breaker locations.

b. U 8G The direct current 24-28 volt electrical system is powered by two generators, each rated at 300-amperes, connected in parallel to the main DC bus and two 12-volt batteries connected in series to the main bus through relays in the positive and negative leads. Two 200-ampere circuit breakers, located on the floorboards, provide protection for the individual generators in case of failure or overload. Other circuit breakers are shown on Figure 2-12.

c. RU 8D A 24-28 volt DC system is powered by two 300-ampere generators connected in parallel to the main bus system and a 24-volt battery located in the outboard side of the left nacelle. Six inverters, of which four are located in the nose compartment, one in the aft cabin area and one in the mission equipment rack, change DC power to alternating current for operating the ASN-64 doppler, the C12 compass, the 26 VAC compass excitation, the drift meter excitation, the glide slope receiver, and the attitude indicators. All other aircraft equipment operates on DC power. Figure 2-13 shows the circuit breaker locations.

d. Battery Lock Switch and Key. The battery lock switch and key located on the engine switch panel (figure 2-5, 2-6, 2-7 or 2-25) controls the DC power circuit for all aircraft DC electrical systems. Turning the key to OFF automatically actuates a mechanical lock mechanism which locks the magneto switches to OFF position and simultaneously cuts off all DC power. Turning the key to ON unlocks the magneto switches and completes the DC circuit through the battery switch.

e. Battery Master Switch. A battery master switch (figure 2-11, 2-12 or 2-13) located on the right subpanel is wired in series with the battery lock switch. The switch is a toggle type placarded BAT OFF. It serves as an emergency cutoff and is normally left in the on position.

f. Generator Master Switches. Two generator master switches placarded GENERATORS are located on the right subpanel adjacent to the battery master switch. The switches are normally left in the on (up) position. Placing either switch in the OFF position disconnects the paralleling circuit as well as the respective generator.

g. Master Switch, Emergency Cutoff. The battery and generator master switches may be cut off simultaneously by a gang bar placarded MASTER SWITCH, extending across the battery and generator master switches.

h. Generator Circuit Breakers. Generator output is furnished to the electrical power distribution system through two 200-ampere circuit breakers located on the floorboards. In the event of malfunction of one generator or its regulating or control system the respective circuit breaker pops out preventing the shorting out of the entire system through the inoperative components.

i. Volt-Ammeters. Two volt-ammeters (figure 2-25, 2-26 or 2-27) normally indicate generator output in amperes. When the spring-loaded pushbutton switch on either instrument is pressed, bus voltage is indicated. Normal indications with generators operating is 28.5 volts. Battery power only is 24 volts. On U-8D ASAC, U-8G and RU-8D aircraft the volt-ammeters are located on the overhead instrument panel.

j. DC electrical System Operation. Check the volt-ammeter occasionally for indication of satisfactory generator operation. A higher or lower than normal ammeter reading indicates only that the generators are not paralleled, a condition which should be rectified prior to the next flight. A variation in generator readings, especially a higher than normal indication, is critical only when the generator load is dangerously close to exceeding the generator's rated capacity. Should an excessively high reading be consistently noted switch OFF that generator for a few seconds. Turn the generator switch on again and note whether the generator output is approximately equal. If the generator readings continue to indicate a considerable spread, discontinue operation of the defective generator.

2-59. Alternating Power Supply System.

a. U-8D STD AC electrical power for operation of the glidescope receiver, gyro magnetic compass indicator, and attitude indicator is provided by two individual AC systems. Power for operation of the glideslope receiver is furnished by either of two single-phase AC 100-volt-ampere inverters, one installed for normal use and the other as a standby. The gyro magnetic compass and pilot's attitude indicator operate from power furnished by either of two (one main and one standby) three-phase AC, 100 volt-ampere inverters. Power required for operation of the inverters is supplied by the aircraft DC electrical system. Two 10-ampere circuit breakers placarded 1 PHASE INVERTER and PHASE POWER on the right subpanel (figure 2-11) protect the inverter wiring circuit.

b. U-8D ASAC Two 750-volt-ampere inverters are installed in the U-8D ASAC. One inverter (main) normally furnishes power for the AC electrical power system. The standby inverter is used to supply power to the main AC power system in the event of main inverter failure. Either inverter is selected by the three-position inverter switch. Figure 2-11 shows the circuit breaker locations.

c. U-8G Two separate sources of alternating current are provided by three inverters. Power for operating the inverters is supplied through the aircraft DC electrical power system. The primary AC system consists of two 250 VA, 115 volt, 400 cycle, single phase inverters, one for normal use and the other for standby. The 250 VA inverters supply power for operating the glide-slope receiver, the gyro magnetic compass, the indicator, the attitude indicator and selsyns in the TACAN and TACAN indicator (ID-663). The gyro magnetic compass, gyro magnetic compass indicator, and the attitude indicator require three-phase power which is converted by a 1 to 3-phase adapter installed in the primary AC supply circuit between the inverters and the equipment. The auxiliary AC power system consists of a 750 VA, 115 volt, 400 cycle, single-phase inverter which furnishes power to operate the TACAN receiver-transmitter only. No standby inverter is provided in the auxiliary AC system. The primary AC power systen is protected by a 25-ampere INVERTER circuit breaker on the right subpanel. The auxiliary AC power system is protected by a 60-ampere, 750 VA INV circuit breaker and a 5-ampere 750 VA INV CONT circuit breaker on the right side of the instrument panel (figure 2-26).

CAUTION

Doppler (AN/ASN-64) must be off before 750 ampere inverters are energized.

d. RU-8D Six inverters provide three separate sources of alternating current for the aircraft. The inverters are powered by the aircraft DC electrical system. Two 750 VA, 115 volt, single-phase inverters, a main and a standby, supply AC power for operating the ASN-64 doppler, C12 compass, 26 VAC compass excitation, and drift meter excitation. The glideslope receiver is operated by AC power provided by two 250 VA, single-phase inverters, one provided for normal use and one for use as a standby. The attitude indicator receives AC power from either of two (one main and one standby) 250 VA three-phase inverters. Protection for the 250 VA single-phase and 250 VA three-phase inverters is provided by two 10-ampere circuit breakers placarded 1 PHASE INVERT and 3 PHASE INVERT located on the right subpanel (figure 2-13). A 60-ampere 750 VA INV DC circuit

breaker located on the overhead power distribution panel provides protection for the ciruit of the 750 VA inverters.

2-60. Alternating Power Controls.

a. Inverter Switches.

(1) U 8D STD Operation of the inverters is controlled by two three-position inverter switches located on the right subpanel (figure 2-11). The switches are placarded OFF, MAIN and STANDBY. Moving the switches from OFF to MAIN position provides inverter power to the respective inverter. In the event of main inverter failure, power can be obtained by placing the inverter switch in STANDBY position.

(2) U 8D ASAC Inverter operation is controlled by a three-position switch placarded, MAIN, OFF and STANDBY located on the right subpanel.

(3) U 8G Operation of the primary AC system (250 VA inverters) is controlled by a selector switch located on the instrument panel (figure 2-26) placarded MAIN-OFF-STBY. In the event of main inverter failure, AC power can be supplied by placing the inverter control switch in STBY position. The auxiliary AC power system (750 VA inverter) is controlled by a circuit breaker located on the right side of the instrument panel.

(4) RU 8D Operation of the 250 VA single-phase and 250 VA three-phase inverters is controlled by two three-position inverter switches. The switches are placarded OFF, MAIN, and STANDBY. Moving the switches from OFF to MAIN position provides inverter power. In the event of main inverter failure, power can be obtained by placing the inverter switch in STANDBY position. Operation of the 750 VA inverters is controlled by a three-position switch, placarded MAIN and STBY, located on the right side of the instrument panel. The MAIN and STBY switch positions provide power to their respective inverters. Power is not supplied to either inverter when the switch is in the center position.

b. Inverter Failure Warning Lights.

(1) U 8D STD Two inverter failure warning lights placarded INVERTER POWER OFF (figure 2-25) are mounted on the upper right side of the instrument panel. Both lights function in the same manner. Failure of either the single-phase or three-phase main or standby inverter will result in the illumination of the corresponding light.

(2) U 8D ASAC A single press-to-test INVERTER FAILURE warning light is mounted on the right side of the instrument panel. Failure of the main or standby inverter will result in illumination of the light.

(3) U 8G Two separate INVERTER FAILURE warning lights are mounted on the right side of the instrument panel; one for the primary AC system 250 VA inverters (both main and standby) and one for the auxiliary AC system 750 VA inverter (main only). Both lights function in the same manner. Inverter failure will result in illumination of the respective inverter light. In event of primary AC system inverter failure, the remaining inverter, either main or standby, may be selected. The auxiliary AC system is not equipped with a standby inverter.

(4) RU 8D Two INV FAILURE warning lights are mounted on the upper right side of the instrument panel. Both lights function in the same manner. Failure of the 250 VA single-phase, or 250 VA three phase, either main or standby inverters, will result in the illumination of the corresponding light. Failure of the 750 VA single-phase main or standby inverter is indicated by the illumination of an inverter failure warning light mounted adjacent to the 750 VA inverter switch.

Section X. LIGHTING

2-61. Exterior Lighting.

Exterior Lighting (figure 2-23) consists of three navigation lights, a passing (taxi) light, a rotating beacon, and two landing lights. Placing any of the exterior lights control switches in the ON position completes the circuit to the associated light. The lighting systems are protected by circuit breakers located on the right subpanel.

a. Navigation Lights. There are three navigation lights: a red light on the left wing tip, a green light on the right wing tip, and a white light on the tail cone. The navigation lights are controlled by two switches placarded ON/NAV LIGHTS/OFF located on the left subpanel and FLASH/NAV LIGHTS/STEADY located on the right subpanel.

b. Passing (Taxi) Light. A white light in the nose cone of the fuselage is controlled by a switch placarded ON/PASSING LIGHT/OFF located on the left subpanel.

c. Rotating Beacon. A red rotating beacon mounted on top of the vertical stabilizer is provided to create a flashing action which is visible for a considerable distance under conditions of restricted visibility. The beacon is controlled by a switch placarded ON/BEACON/OFF located on the right subpanel.

CAUTION

Alternate between the left and right light when the landing lights are used in taxiing as the flow of air is insufficient to prevent overheating of the shields.

d. Landing Lights. The left and right landing lights located on the leading edge of the ouboard wing panels are individually operated by two switches placarded ON/L LDG LIGHT/OFF and ON/R LDG LIGHT/OFF located on the left subpanel (figure 2-11).

2-62. Interior Lighting.

Instrument panel lighting is provided by individual red lights installed at the edge of each instrument, plus two cabin red lights which are located overhead and are positioned to shine directly on the instrument panel. Additional interior lighting includes an overhead map light, overhead cabin reading lights, edge-lighted panel lights, circuit breaker panel lights, cabin step light, compass light, indicator lights, and utility lights. Six rheostat-type switches (figure 2-24) located on the overhead lighting control panel directly above the center seat, are used to control all lighting within the cabin, except the overhead reading lights, utility lights, and the circuit breaker panel lights. Each rheostat is placarded to indicate which lighting circuit it controls. Clockwise rotation of the rheostat knobs on the overhead control panel first turns the lights on dim and then progressively increases the intensity of the light. The overhead reading light and the utility lights are turned on and off with a switch installed as an integral part of each light. The nose compartment lights, and the outside step light and cabin step light are controlled by microswitches which are actuated by the nose compartment access doors and cabin door respectively. The circuit breaker panel lights are operated by a switch on the right subpanel.

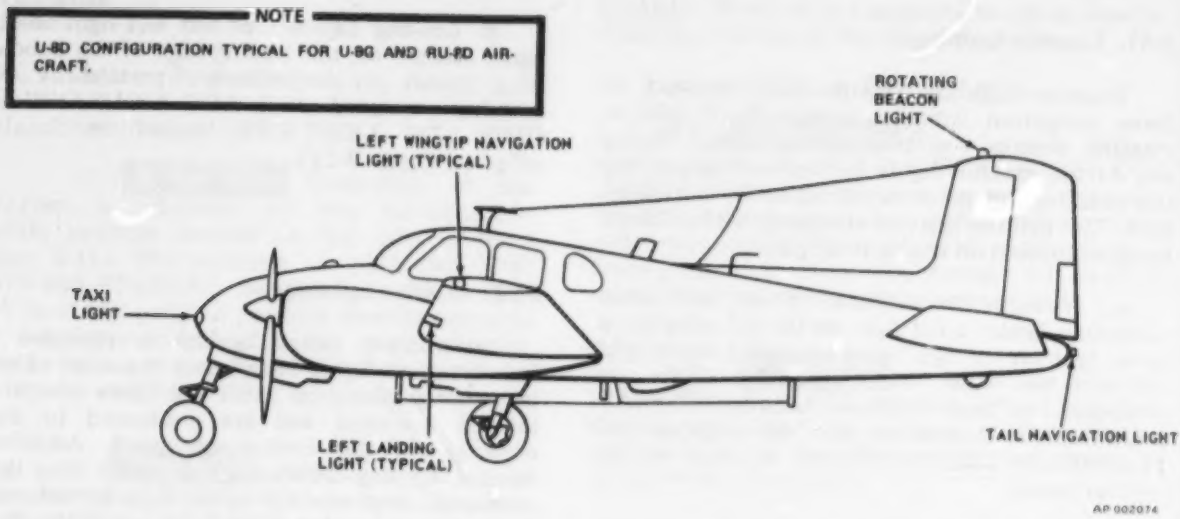


Figure 2-23. Exterior Lighting (Typical)

Section XI. FLIGHT INSTRUMENTS

2-63. Turn-and-Slip Indicator.

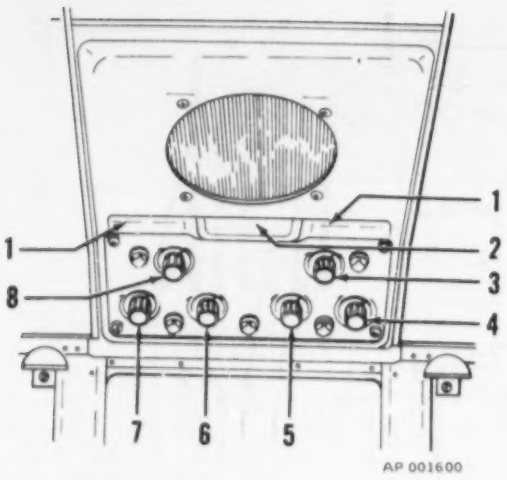
The turn-and-slip indicator located on the left side of the instrument panel (figure 2-25, 2-26 or 2-27) operates directly from the aircraft DC power supply system and is utilized to provide visual indication of the direction, rate and coordination of a turn.

2-64. Pitot-Static System.

The pitot-static system supplies static pressure to the altimeters and vertical velocity indicator, and static pressure plus pitot (ram air) pressure to the airspeed indicators. The system consists of a single pitot tube mounted on the underside of the left wing leading edge for impact air, and static air pressure ports in the aircraft exterior skin on each side of the aft fuselage. The pitot tube is protected from ice formation by internal electric heating elements. Refer to Pitot and Stall Warning Heat System, Section VII. Emergency static air source is not provided.

a. Airspeed Indicators. On U-8D, U-8D ASAC and U-8G aircraft two airspeed indicators are installed separately on the pilot and copilot sides of the instrument panel (figure 2-25 or 2-26). On RU-8D aircraft one airspeed indicator is installed on the pilot's side of the instrument panel (figure 2-27). These indicators require no electrical power for operation.

b. Pilot's Encoding Altimeter. The pilot's encoding altimeter is located on the left side of the instrument panel (figure 2-25, 2-26 or 2-27). The altimeter is a self-contained unit which consists of a precision pressure altimeter combined with an altitude encoder. The display indicates and the encoder transmits, simultaneously, pressure altitude reporting. Altitude is displayed on the



1. Cabin red lights
2. Map (dome) light
3. Cabin red lights control
4. Map lights control
5. Radio and switch panel lights control
6. Engine instrument panel lights control
7. Flight instrument panel lights control
8. Fuel panel and tab indicator light control

Figure 2-24. Overhead Control Panel

altimeter by a 10,000 foot counter, a 1000 foot counter, a 100 foot counter and a single needle pointer which indicates hundreds of feet on a circular scale in 50 ft increments. Below an altitude of 10,000 feet, a diagonal warning symbol will appear on the 10,000 foot counter. A barometric pressure setting knob is provided to insert the desired altimeter setting in inches Hg. A DC powered vibrator operates inside the altimeter whenever aircraft power is on. If DC power to the altitude encoder is lost, a warning flag placarded CODE OFF will appear in the upper left portion of the instrument face, indicating that the altitude encoder is inoperative and that the system is not reporting altitude to ground stations. For operating instructions, refer to Chapter 3.

c. Copilot's Altimeter U-8D U-8G The copilot's altimeter (AAU-31A) is located on the upper right side of the instrument panel. It is a precision pressure altimeter which displays altitude on a 10,000 foot counter, a 1000 foot counter, a 100 foot counter and a single needle pointer which indicates hundreds of feet on a circular scale in 50 foot increments. Below an altitude of 10,000 feet, a diagonal warning symbol will appear on the 10,000 foot counter. A barometric pressure setting knob is provided to insert the desired altimeter setting in inches Hg. A DC powered vibrator operates inside the altimeter whenever aircraft power is on. The altimeter indicates pneumatic altitude reference to the barometric pressure level as selected with the barometric setting knob. At ambient pressure, altimeter should agree within ±75 feet of the field elevation when the proper barometric pressure setting is set in the window.

NOTE

If the altimeter does not read within 75 feet of field elevation when the correct local barometric setting is used, the altimeter needs re-zeroing or internal failure has occured. An error of greater than 75 feet also nulifies use of the altimeter for IFR Flight.

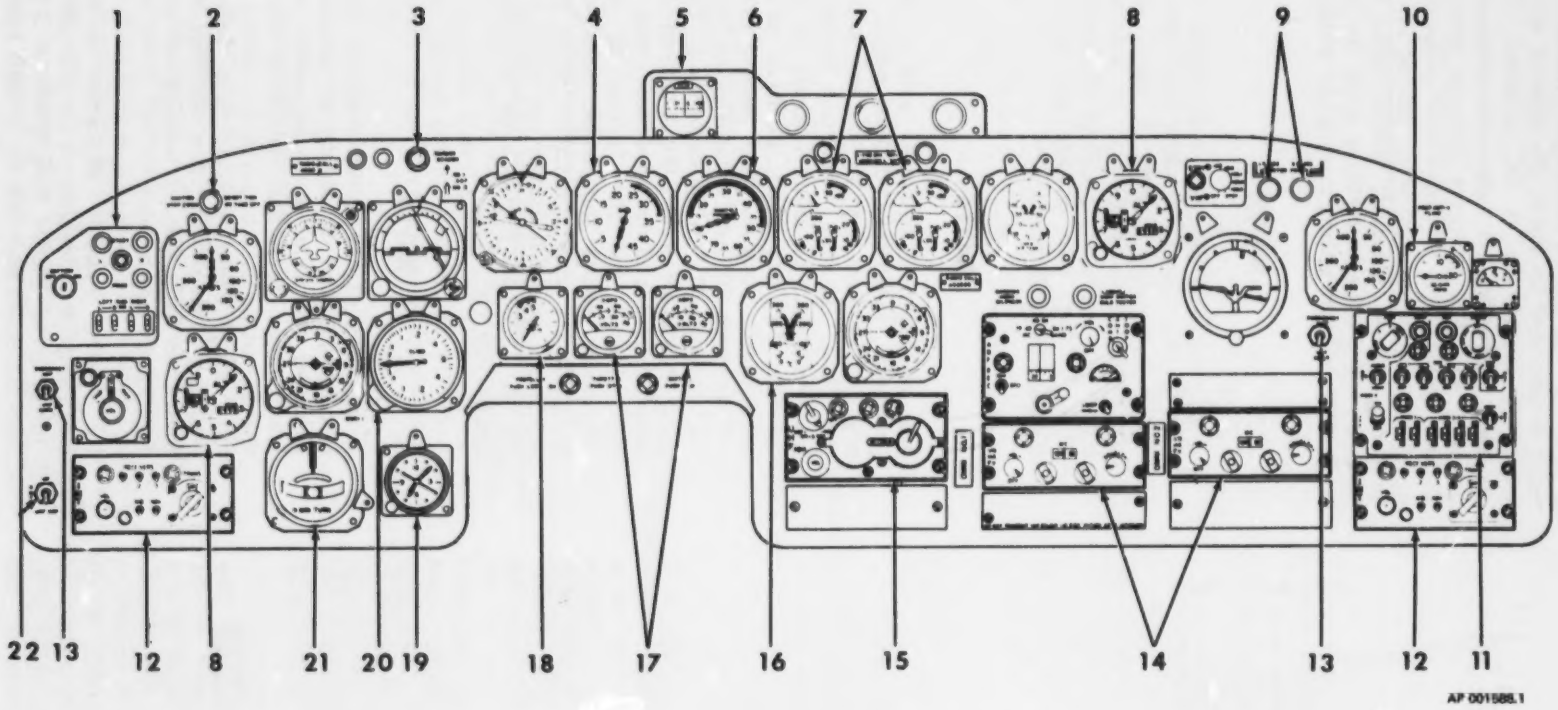
NOTE

The altimeter is equipped with a DC powered internal vibrator which is required to overcome friction and assure accuracy. If the vibrator becomes inoperative due to internal failure or DC power failure, the pointer may momentarily hang up when passing from "9" through "0" while climbing, or from "0" through "9" while descending. This hang up will cause lag, the magnitude of which will depend on the vertical speed of the aircraft and the friction in the altimeter. Pilots should be especially watchful for this type failure when the minimum approach altitude lies within the "8" to "1" part of the scale 800-1100, 1800-2100, etc.

NOTE

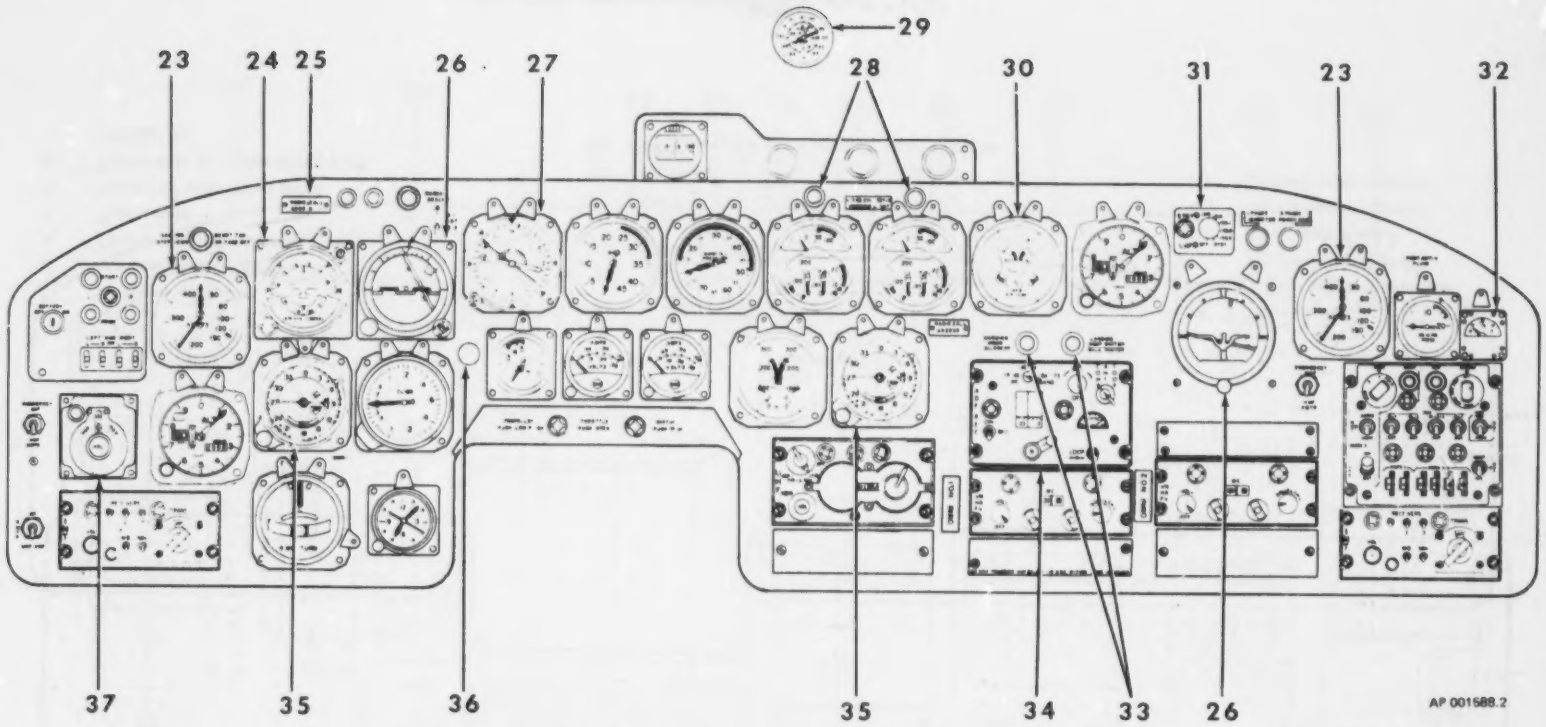
A minimum of one minute warm-up time is required prior to setting or checking altimeter operation. If the barometric set knob binds or sticks, abnormal force should not be used to make the setting as this may cause internal gear failure resulting in an altitude error. Settings can sometimes be made by backing off and turning at a slower rate.

d. Vertical Velocity Indicator. A vertical velocity indicator is installed on the left side of the instrument panel (figure 2-25, 2-26, or 2-27). It indicates the speed at which the aircraft ascends or



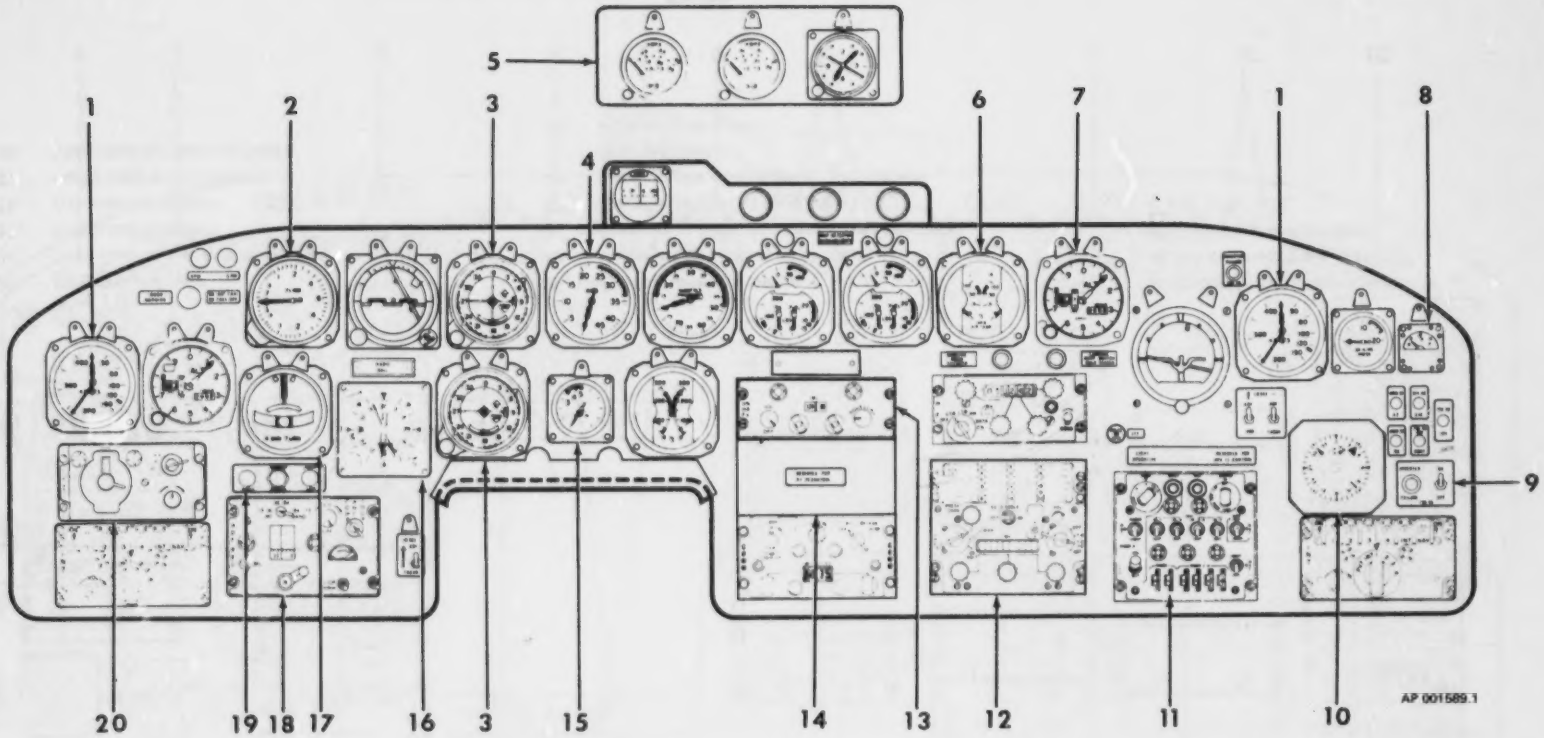
1. Engine switch panel
2. Cabin step warning light
3. Marker beacon light
4. Tachometer
5. Magnetic compass
6. Manifold pressure gage
7. Engine gage units
8. Altimeter
9. Inverter failure warning lights
10. Deicer pressure gage
11. Transponder control panel
12. Audio control panels
13. Emergency transmitter switches
14. VOR control panels
15. UHF control panel
16. Cylinder head temperature gage
17. Volt-ammeters
18. Suction gage
19. Clock
20. Vertical velocity indicator
21. Turn-and-slip indicator
22. HF-VHF transmitter selector switch

Figure 2-25. Instrument Panel U-8D *(Typical) (sheet 1 of 2)*



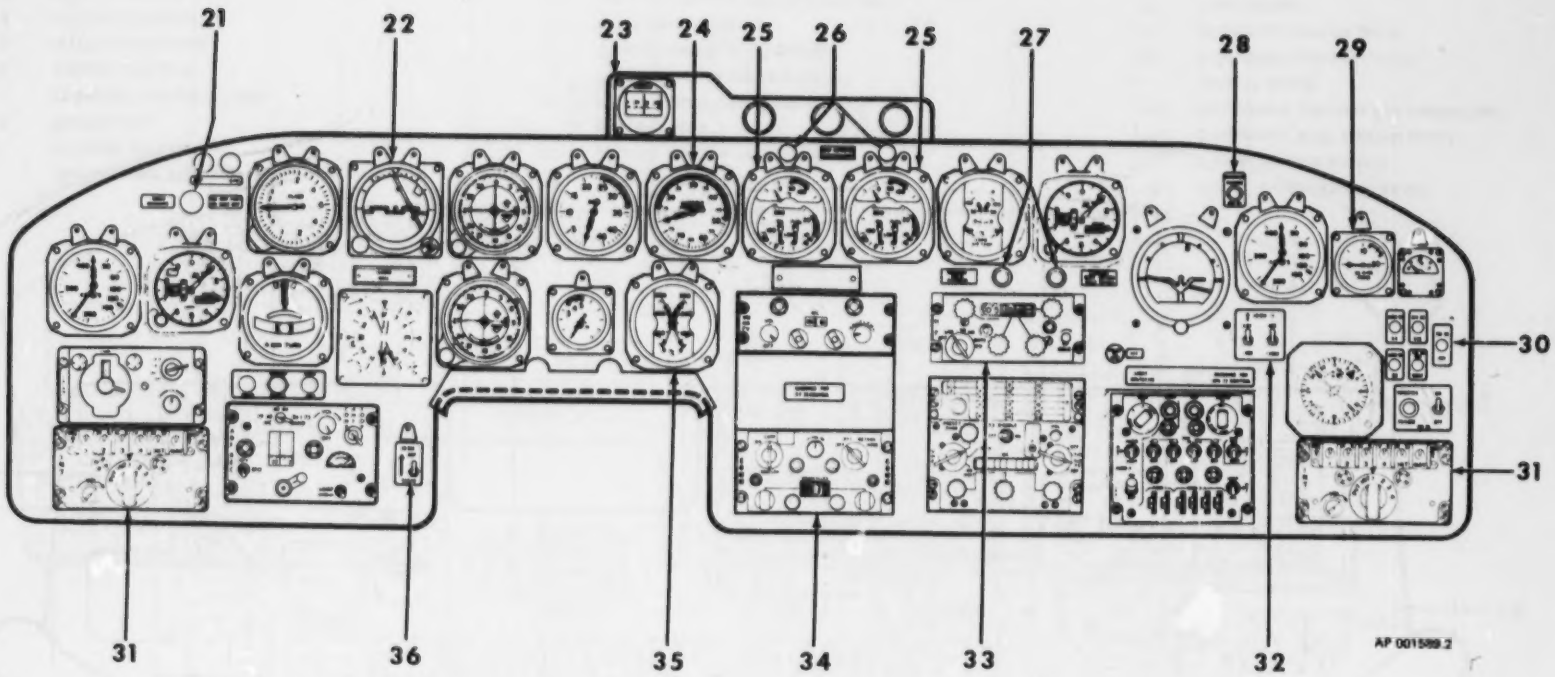
23. Airspeed indicator
24. Gyro magnetic compass indicator
25. Radio call number
26. Attitude indicators
27. Radio magnetic indicator
28. Chip detector warning lights
29. Free air temperature gage
30. Carburetor air temperature gage
31. Emergency VHF transmitter control panel
32. Propeller anti-icing fluid gage
33. Landing gear warning horn silencer and light test button
34. ADF control panel
35. Course Indicator selectors
36. Marker beacon audio control
37. Glideslope control panel

Figure 2-25. Instrument Panel U-8D *(Typical) (sheet 2 of 2)*



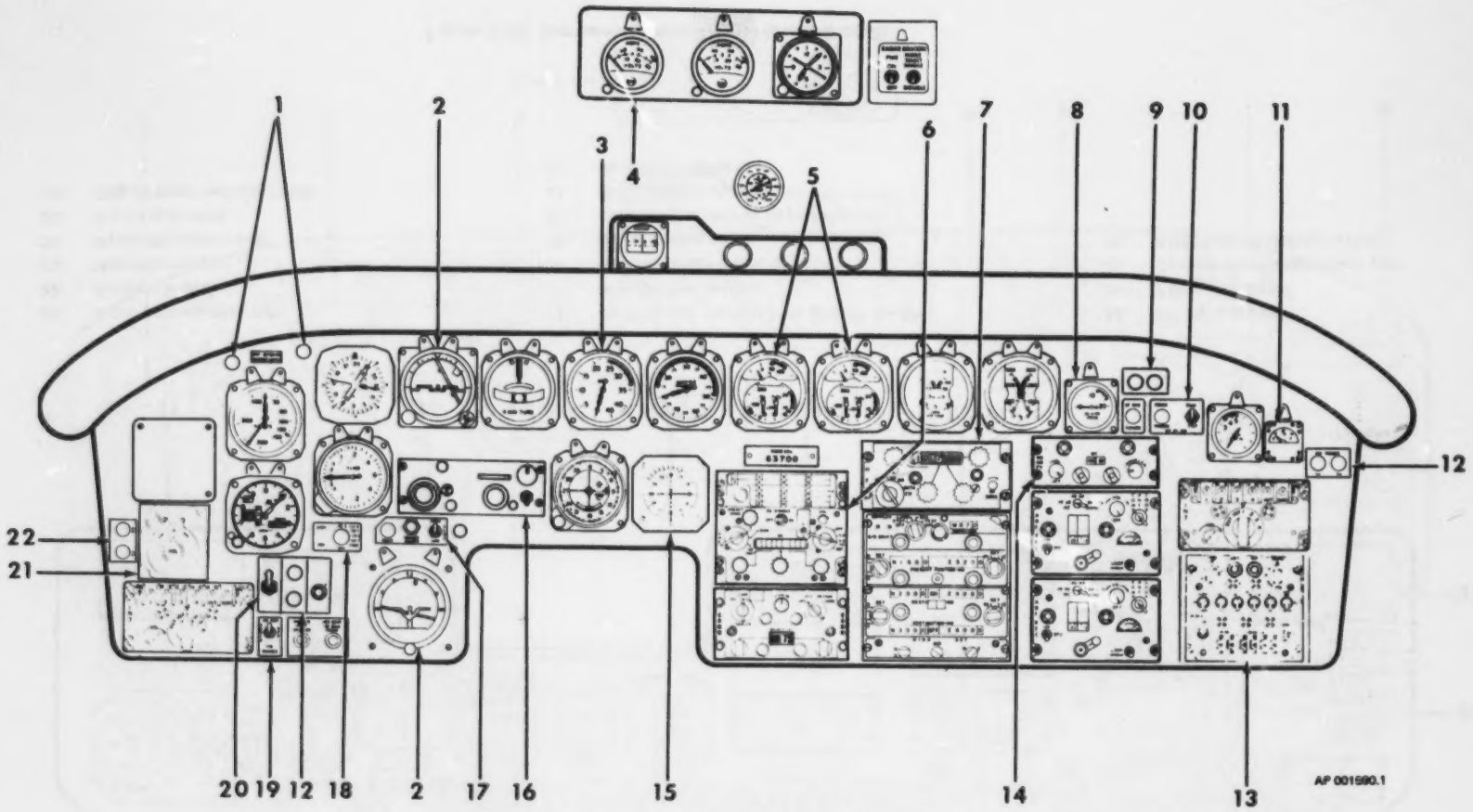
1. Airspeed indicators
2. Vertical velocity indicator
3. Course indicator-selectors
4. Tachometer
5. Overhead instrument panel
6. Carburetor air temperature gage
7. Altimeters
8. Propeller anti-icing fluid gage
9. 750 VA inverter switch and warning light
10. Bearing distance heading indicator
11. Transponder control panel
12. UHF control panel
13. VOR control panel
14. Provisions for noise security control panel
15. Suction gage
16. Radio magnetic indicator
17. Turn and slip indicator
18. ADF control panel
19. Marker beacon control
20. TACAN control panel

Figure 2-26. Instrument Panel U-8G (sheet 1 of 2)



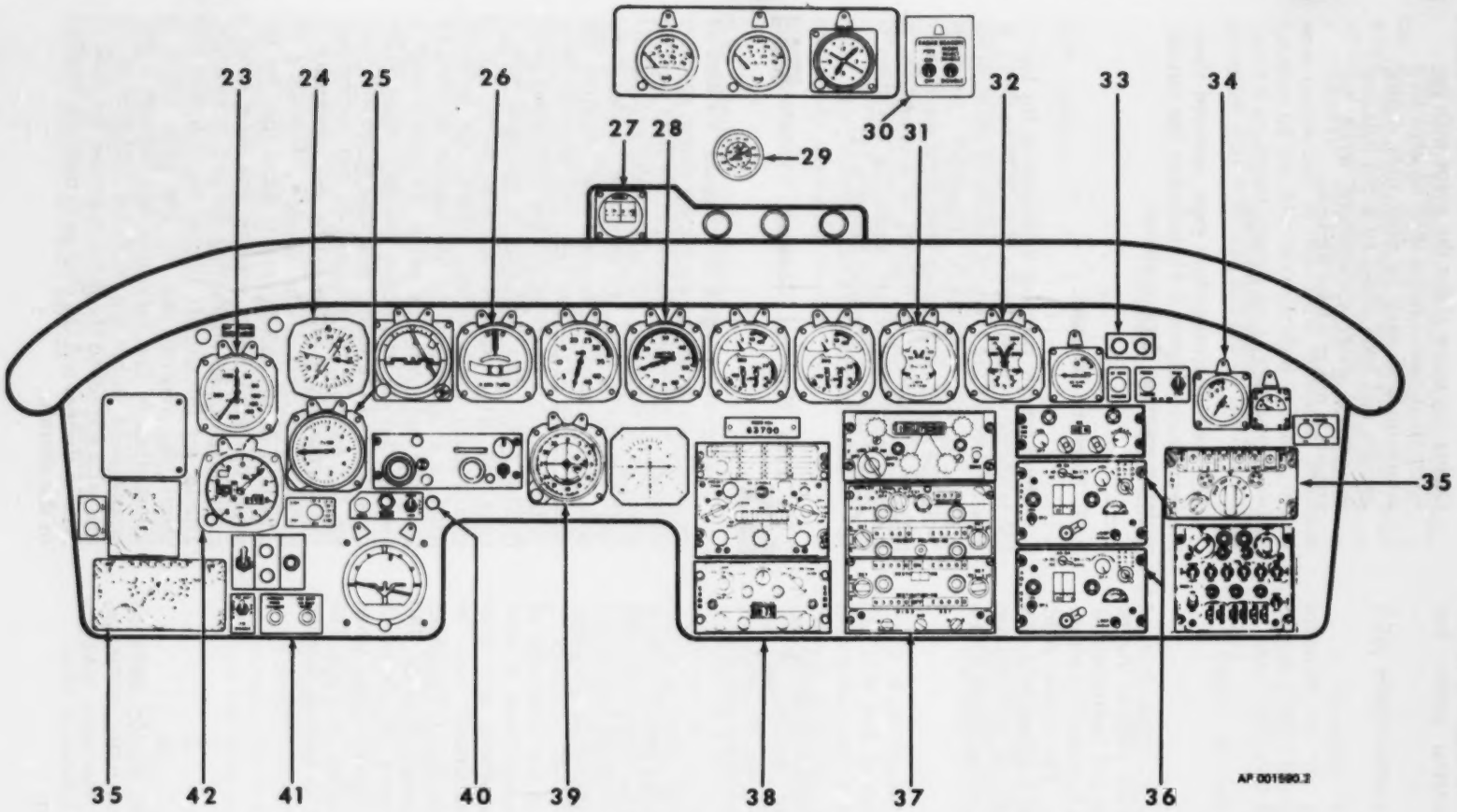
21. Cabin door warning light
22. Attitude indicator
23. Magnetic compass
24. Manifold pressure gage
25. Engine gage units
26. Chip detector warning lights
27. Landing gear warning horn silencer switch and light test button
28. Inverter failure warning light
29. Deicer pressure gage
30. Avionics and inverter circuit breakers
31. Audio control panels
32. Navigation switches
33. HF control panel
34. FM control panel
35. Cylinder head temperature gage
36. ADF/TACAN selector switch

Figure 2-26. Instrument Panel U-8G (sheet 2 of 2)



1. Chip detector warning lights
2. Attitude indicators
3. Tachometer
4. Overhead instrument panel
5. Engine gage units
6. UHF control panel
7. HF control panel
8. Deicer pressure gage
9. Voice security indicators
10. 750 VA inverter switch and warning light
11. Propeller anti-icing fluid gage
12. Inverter failure warning lights
13. Transponder control panel
14. VOR control panel
15. Doppler velocity steering indicator
16. Gyrocompass control panel
17. Marker beacon control
18. Emergency VHF control panel
19. Equipment operator FM transmitter control switch
20. ADF/VOR selector switch
21. Glideslope control panel
22. Fuse holders

Figure 2-27. Instrument panel RU-8D *(sheet 1 of 2)*



23. Airspeed indicator
24. Radio magnetic indicator
25. Vertical velocity indicator
26. Turn and slip indicator
27. Magnetic compass
28. Manifold pressure gage
29. Free air temperature gage
30. Radar beacon control
31. Carburetor air temperature gage
32. Cylinder head temperature gage
33. HF warning light
34. Suction gage
35. Audio control panels
36. ADF control panels
37. Doppler control panel
38. FM control panel
39. Course indicator-selector
40. DF indicator
41. Landing gear warning horn silencer and light test button
42. Altimeter

Figure 2-27. Instrument Panel RU-8D *(sheet 2 of 2)*

descends based on changes in atmospheric pressure. The indicator is a direct reading pressure instrument requiring no electrical power for operation.

2-65. Attitude Indicators.

CAUTION

The caging knob shall not be pulled violently.

a. Two attitude indicators are utilized (figure 2-25, 2-26 or 2-27). The upper left instrument is operated by alternating current furnished by either the main or standby inverter. The upper right instrument (lower left on RU-8D) differs from the electrical instrument in three respects: it is vacuum operated, distinctly larger, and not equipped with a caging knob and indicating flag.

NOTE

The OFF flag on the electrical instrument is not an indication or warning of malfunction. The signal notifies the pilot that the instrument is not receiving power.

b. Each attitude indicator is equipped with a fixed symbol in front of the face, which represents the aircraft, and a movable horizontal bar behind the aircraft symbol, which represents the horizon. The aircraft symbol may be adjusted vertically by means of a small knob located at the lower edge of each indicator to correct for variations in level flight attitude at different airspeeds and gross weights. The electrical instrument may be momentarily caged by pulling the PULL TO CAGE knob, but is designed to operate through 360 degrees of roll and 85 degrees of pitch. A controlled precession of 180 degrees occurs when the aircraft approaches 90 degrees in pitch. The vacuum instrument is designed to operate through 110 degrees of roll and 55 degrees of pitch.

NOTE

A temporary displacement of the gyro from its normal position during turns, commonly referred to as turn error, may be introduced into the indicators when normal turns are performed.

NOTE

Caging the gyros aligns the gyros with the instrument case. Caging shall be kept to a minimum and shall be done only during straight and level flight to avoid inducing temporary errors experienced when the aircraft is not in a level attitude.

2-66. Free Air Temperature Gage.

The free air temperature gage, centered above the windshield (figure 2-4), indicates the outside air temperature in degrees celsius.

2-67. Magnetic Compass.

The magnetic compass is located on the top of the instrument panel (figure 2-25, 2-26 or 2-27). It may be used in the event of failure of the compass system, or for instrument crosscheck. Readings should be taken only during level flight since errors may be introduced by turning or acceleration. A compass correction chart indicating deviation is located on the left subpanel (figure 2-11).

2-68. Gyro Magnetic Compass Indicator. U 8D STD

The gyro magnetic compass installation consists basically of an electrically driven gyro and indicator. A flux valve, located in the right wing tip serves as a reference for slaving the gyro to the earth's magnetic field. An amplifier, located in the nose compartment, interprets and amplifies the sensing signals of the flux valve and transmits them to the indicator mounted on the instrument panel (figure 2-25). The indicator is equipped with a rotating dial against a fixed index and a synchronizer knob. Before takeoff, the indicator must be synchronized to the heading detected by the wing mounted flux valve. An annunciator is used to indicate whether or not the reading on the indicator and the sensed direction of the flux valve are the same. If the readings do not correspond, the discrepancy is evidenced by the appearance of a dot or a cross in the window, depending on direction of the misalignment. When they are the same, the annunciator window will show either a clear image or an alternating dot and cross image. Turning of the aircraft rotates the indicator case about the vertical axis of the gyro which is transmitted to the indicating dial through a gear arrangement within the indicator. Rotation of the dial with respect to the index indicates the angle of turn in degrees and the change in magnetic heading of the aircraft.

2-69. Radio Magnetic Indicators (RMI). U-8D ASAC U-8G RU-8D

The radio magnetic indicators (RMI) combine the ADF, VOR, and TACAN indications into a single, direct reading instrument (figure 2-25, 2-26 or 2-27). Aircraft heading information is relative to a magnetic bearing since the indicator is servo-connected to the gyro compass. Selective function of the RMI is controlled in the ADF and TACAN equipped aircraft by a two-position switch placarded ADF/TACAN, located on the instrument panel to the left of the control pedestal. Refer to Chapter 3, Avionics, for coverage of the RMI.

2-70. Miscellaneous Instruments.

A standard 8-day manual wind clock is mounted on the instrument panel of the U-8D (figure 2-25) and on the overhead instrument panel of the U-8G and RU-8D aircraft (figure 2-26 or 2-27).

Section XII. SERVICING, PARKING, AND MOORING

2-71. General.

The following paragraphs include the procedures necessary to completely service the aircraft, except lubrication (figure 2-28). The lubrication requirements of the aircraft are covered in TM 55-1510-201-20. Refer to Tables 2-4 and 2-5 for identification of fuel, oil, etc., used to service the aircraft. The servicing instructions give, in detail, the procedures and precautions necessary to completely service the aircraft.

2-72. Servicing Fuel System.

The fuel system contains eight bladder type fuel cells (figure 2-18) which have a total capacity of 230 gallons. The main fuel tanks are located, one in each wing root, between the fuselage and the engine nacelle. They are interconnected to provide a crossfeed from either main tank to either or both engines. The access doors from the main fuel tanks are flush mounted on the upper surface of the wing between the nacelle and the fuselage. Sump drains are provided on the underside of the wing. Each main fuel tank has an expansion volume of 0.9 gallon, a sump capacity of 0.06 gallon, and a total capacity of 44 gallons, to make a new fuel capacity of 43.94 gallons. The auxiliary cells in each wing function as a tank. The cells are interconnected. A single fuel supply line draws from all three auxiliary fuel cells simultaneously. The auxiliary cells are filled through a single filler neck located in each outboard wing panel and their common level is indicated on a single gage. The fuel sump drains, located in each of the aft inboard auxiliary cells, should be drained before each flight. With an expansion volume of 1.5 gallons and a sump capacity of 0.06 gallon, each auxiliary fuel tank has a total fuel capacity of 71 gallons and a net fuel capacity of 70.94 gallons.

NOTE

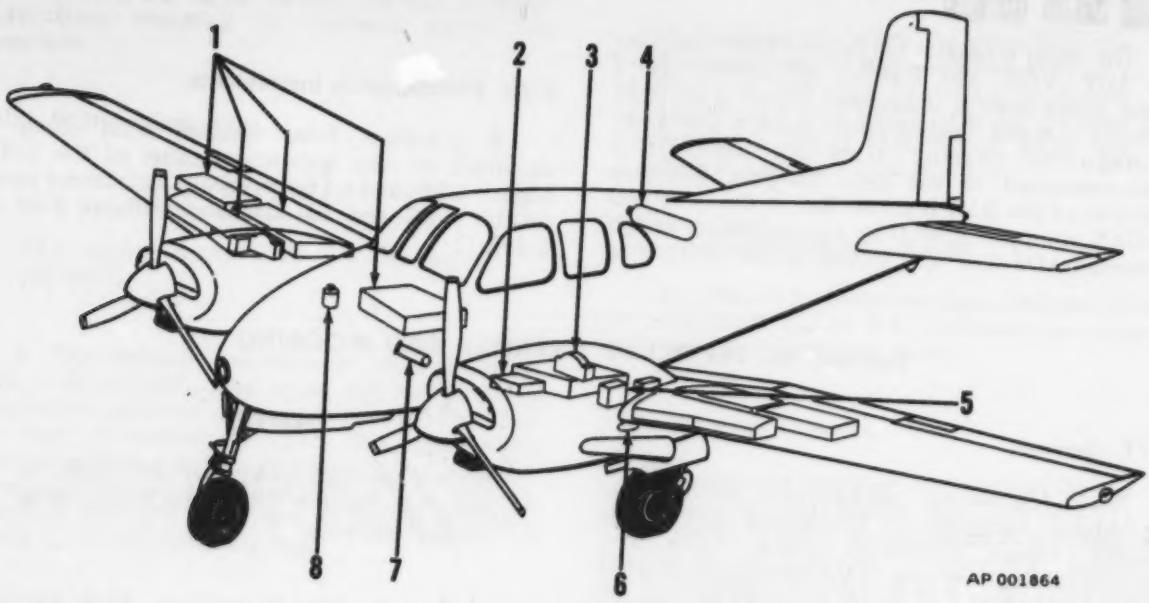
Service the fuel tanks after each flight to keep the bladder type cells from drying out and cracking.

a. Fuel Handling Precautions. While handling fuel it is well to remember that gasoline has highly flammable and explosive properties. Since it is heavier than air, dangerous concentrations of gasoline vapor often form at points of escape from the fuel tanks making breathing hazardous in the immediate vicinity of such concentrations. These pockets of vapor are also a potential source of explosion or fire which can be touched off by sparks of static electricity, sparks from tools, hot exhaust sparks, lighted cigarettes, electrical devices, or any heat producing agency. To insure a maximum amount of safety during fueling the following precautions shall be observed:

CAUTION

When conditions permit, the aircraft shall be positioned so that the wind will carry the gasoline vapors away from all possible sources of ignition. The fueling vehicle shall be positioned to maintain a minimum distance of 10 feet from any part of the aircraft, while maintaining a minimum distance of 20 feet between fueling vehicle and fuel filler point.

1. When possible, service the aircraft with cold soaked fuel, as cold soaked fuel has been chilled until the volume decreases, thereby allowing more fuel to be carried in the fuel tanks.



1. Fuel tanks (typical left and right)
   Fuel: Spec. MIL-G-5572 (Grade 100/130)

2. Anti-icing fluid reservoir
   Anti-icing fluid: Spec. TT-1-735

3. Engine oil tanks (typical left and right)
   Engine oil: Spec. MIL-L-22851 Type II, above +60°F
   Engine oil: Spec. MIL-L-22851 Type III, from +5°F to +60°F

4. Oxygen supply cylinder
   Breathing oxygen: Spec. MIL-O-27210

5. Battery

6. External power receptacle (24-volt)

7. Fire extinguisher, hand type CF_3Br

8. Wheel brake fluid reservoir
   Hydraulic fluid: Spec. MIL-H-5606

Figure 2-28. Servicing Locations (Typical)

Table 2-4. Fuel, Lubricants, Specifications, and Capacities

SYSTEM	SPECIFICATION	CAPACITY
Fuel	MIL-G-5572, 100/130	230 U.S. Gals.
Engine Oil	MIL-L-22851, Type II (above +60°F)	8 U.S. Gals. (4 ea. engine)
	MIL-L-22851, Type III (below +60°F) (See Note 1.)	
Brake fluid hydraulic	MIL-H-5606	1 U.S. pint
Oxygen system	MIL-O-27210	64 cubic feet

NOTE 1: In operating areas where the temperature is so low the engine will not start, the oil should be heated. Oil may be drained from aircraft and stored in a warm place until required.

2. Shut off all electrical equipment on the aircraft, including radar and radar equipment. Do not service batteries during the fueling operation. The master switches may be left on, but they must not be operated during the fueling operation. Do not operate any electrical tools such as drills or buffers in or near the aircraft during fueling.

3. Refuel the aircraft as soon as possible after landing.

4. Keep fuel servicing nozzles free of snow, water and mud at all times.

WARNING

Prior to opening the fuel tank filler, the nozzle static wire clamp must be attached to the wing.

5. Carefully remove snow, water, and ice from the aircraft fuel filler cap area before removing the fuel filler cap. Remove only one aircraft tank filler cap at any one time, and replace each one immediately after the servicing operation is completed.

6. Wipe frost from fuel filler neck.

7. Drain water from fuel tanks, filler cases, and pumps 15 minutes after each servicing, 30 minutes after each removal from heated shelter, and after each flight. Preheat, when required, to ensure free fuel drainage.

8. Insofar as possible, leave only fully serviced aircraft outside.

9. Avoid dragging the gasoline hose where it can damage the soft, flexible surface of the deicer boots.

10. Insure that the aircraft and components being serviced are securely coupled to a low resistance ground. Connect the static ground cable and the fueler to a grounding stake. When engaged in the fueling operation, discharge the static electricity accumulated by the body and clothing by touching the ground cable or stake before each operation.

11. Observe NO SMOKING precautions.

12. Prior to transferring the fuel, insure that the hose is grounded to the aircraft.

13. Wash off spilled fuel immediately.

14. Handle the fuel hose and nozzle cautiously to avoid damaging the wing skin.

15. Do not conduct fueling operations within 100 feet of energized airborne radar equipment or within 300 feet of energized ground radar equipment installations.

16. Wear only nonsparking shoes near aircraft or fueling equipment as shoes with nailed soles or metal heel plates can be a source of sparks.

Table 2-5. Approved Fuels

ENGINE MODEL	ARMY STANDARD FUEL	ALTERNATE FUEL	EMERGENCY FUEL
0-480-1	MIL-G-5572 100/130	MIL-G-5572 115/145	None

b. Fuel Handling Precautions for Extreme Weather Conditions. When fueling is conducted on ice or on sandy desert terrain, or when a satisfactory ground cannot be secured, additional precautions must be taken to avoid the buildup of static electricity. Since draining the static charges is not possible without an adequate ground, reliance must be placed on equalizing the potentials in order to prevent a dangerous sparking discharge, as in the following bonding procedure.

1. Connect grounding cable from fuel truck or drum to satisfactory ground such as grounding post.

NOTE

Grounding posts usually consist of pipes or rods .5 to .75 inch in diameter. These rods are usually made of galvanized iron, steel, or copper weld steel and are driven far enough into the ground to reach below the permanent ground moisture level point.

2. Connect grounding cable from ground to some convenient unpainted part of the aircraft, excluding propellers or antennas.

3. Connect bonding cable from fuel truck or drum to aircraft. A conductive type fuel hose is not a satisfactory method of bonding.

4. Connect bonding cable from fuel nozzle to aircraft before fuel tank cover is opened.

c. Filling Fuel Tanks. Fill fuel tanks as follows:

1. Attach bonding cables to aircraft and fuel servicing unit.

2. Open applicable fuel tank access door.

3. Attach bonding cable from hose nozzle to ground sockets adjacent to fuel tank being filled. Touch hose nozzle to aircraft surface to discharge static electricity.

4. Remove filler cap from filler neck and insert hose nozzle in filler neck.

5. Fill fuel tank with 100/130 AVGAS (115/145 alternate).

6. Remove hose nozzle from filler neck and install filler cap on filler neck when fuel tank has been filled.

7. Secure applicable fuel tank access door.

8. Remove bonding cables from aircraft and fuel servicing unit.

d. Draining Moisture from Fuel System. To remove moisture and sediment from the aircraft fuel system, a quick drain is provided in each fuel tank and a drain valve is provided in each fuel system strainer. Take fuel samples from fuel tanks and fuel system strainers daily, or more frequently as operating conditions require. Draw approximately 1/3 pint of fuel from each source.

2-73. Fuel Types.

a. Army Standard Fuels. These are the Army designated primary fuels adopted for worldwide use, and the only fuels available in the Army supply system.

b. Alternate Fuels. These are fuels which can be used continuously when Army Standard fuel is not available, without reduction of power output. Power setting adjustments and increased maintenance may be required when an alternate fuel is used.

2-74. Servicing Oil System.

An oil tank is installed in each nacelle aft of the engine firewall (figure 2-28). An access door is provided in the nacelle for filling the oil tank and checking the oil level.

a. Cold Weather Maintenance of Oil System. If ambient temperature is below +5°F the aircraft should be serviced with MIL-22851 Type II. In extremely cold weather, it may be necessary to

preheat the oil prior to starting. Avoid operating engines excessively on the ground. The danger of condensation in oil tanks necessitates frequent checking and draining of the oil sumps. Since metal contraction often leads to leakage, the oil lines must be checked frequently.

b. Filling Oil System. Fill the oil system as follows:

1. Remove applicable access door on top of engine nacelle to gain access to oil tank filler neck.

2. Remove oil filler cap.

3. Insert hose nozzle from oil servicing unit or spout of an oil can in filler neck.

4. Fill oil tank to full mark on dipstick.

NOTE

Avoid spilling oil. Any oil spilled must be removed immediately. Use a cloth moistened in dry cleaning solvent P-D-680 to remove oil.

5. Install oil filler cap and fasten access door on engine nacelle.

2-75. Servicing Hydraulic Brake System Reservoir.

1. Gain access to wheel brake fluid reservoir (figure 2-28).

NOTE

The hydraulic brake system reservoir is located on the left side of the rear bulkhead in the nose baggage compartment.

2. Remove cap and fill reservoir with MIL-H-5606 hydraulic fluid. Stop 1 inch from top.

3. Install cap.

2-76. Inflating Tires.

Inflate tires as follows:

1. Inflate nose wheel tire to a pressure between 30 and 35 PSI.

2. Inflate main wheel tires to a pressure between 40 and 43 PSI.

2-77. Anti-Icing, Deicing and Defrosting Protection.

The aircraft is protected in subfreezing weather by spraying the surfaces (to be covered with protective covers) with defrosting fluid. Spraying defrosting fluid on aircraft surfaces before installing protective covers will permit protective covers to be removed with a minimum of sticking. To prevent freezing rain and snow from blowing under protective covers and diluting the fluid, insure that protective covers are fitted tightly. As a deicing measure, keep exposed aircraft surface wet with fluid for protection against frost.

NOTE

Do not apply anti-icing, deicing and defrosting fluid on exposed aircraft surfaces if snow is expected. Melting snow will dilute the defrosting fluid and form a slush mixture which will freeze in place and become difficult to remove.

2-78. Anti-Icing, Deicing and Defrosting Treatment.

Use undiluted anti-icing, deicing and defrosting fluid (MIL-A-8243) to treat aircraft surfaces for protection against freezing rain and frost. Spray aircraft surface sufficiently to wet area, but without excessive drainage. A fine spray is recommended to prevent waste. Use diluted, hot fluid to remove ice accumulations.

1. Remove frost or ice accumulations from aircraft surfaces by spraying with diluted anti-icing, deicing, and defrosting fluid mixed in accordance with Table 2-6.

2. Spray diluted, hot fluid in a solid stream (not over 15 gallons per minute). Thoroughly saturate aircraft surface and remove loose ice. Keep a sufficient quantity of diluted, hot fluid on aircraft surface coated with ice to prevent liquid layer from freezing. Diluted, hot fluid should be sprayed at a high pressure, but not exceeding 300 PSI.

3. When facilities for heating are not available and it is deemed necessary to remove ice accumulations from aircraft surfaces, undiluted defrosting fluid may be used. Spray undiluted defrosting fluid at 15 minute intervals to assure compl

Table 2-6. Recommended Fluid Dilutions Chart

AMBIENT TEMPERATURE (°F)	PERCENT DEFROSTING FLUID BY VOLUME	PERCENT WATER BY VOLUME	FREEZING POINT OF MIXTURE (°F) (APPROXIMATE)
+30°	20	80	+10°
+20°	30	70	0°
+10°	40	60	-15°
0°	45	55	-25°
-10°	50	50	-35°
-20°	55	45	-45°
-30°	60	40	-55°

NOTES:
1. Use anti-icing and deicing fluid (MIL-A-8243).
2. Heat mixture to a temperature of 180° to 200°F (82° to 93°C)

complete coverage. Removal of ice accumulations using undiluted defrosting fluid is expensive and slow.

4. If tires are frozen to ground, use undiluted defrosting fluid to melt ice around tire. Move aircraft as soon as tires are free.

2-79. Servicing Anti-Icing System.

Access to the anti-icing supply tank filler (figure 2-28) is provided by a door located on the upper surface of the left wing. The supply tank should be checked and filled with anti-icing fluid before each cold weather flight. Fill the anti-icing system as follows:

1. Gain access to anti-icing supply tank filler by opening propeller anti-icing access door (figure 2-28).

2. Remove filler cap.

3. Fill anti-icing supply tank to proper level with anti-icing fluid.

4. Install filler cap. Secure propeller anti-icing system access door.

2-80. Application of External Power.

CAUTION

Before connecting the power cables from the external power source to the aircraft, insure that the generator is not touching the aircraft at any point. Due to the voltage drop in the cables, the two ground systems will be off different potentials. Should they come in contact while the generator is operating, arcing could occur. Turn off all external power while connecting the power cable to, or removing it from the external power supply receptacle.

CAUTION

Be certain that the polarity of the external power source is the same as that of the aircraft before it is connected.

An external power source is often needed to supply the electric current required to properly ground service the aircraft electrical equipment and to facilitate starting the aircraft's engines. An external power receptacle is installed on the outboard side of the left engine nacelle (figure 2-28). Since the external supply receptacle is

directly connected to the aircraft bus system, external power is available regardless of the position of the battery switch.

2-81. Servicing Oxygen System.

a. Oxygen System Safety Precautions.

WARNING

Keep fire and heat away from oxygen equipment. Do not smoke while working with or near oxygen equipment, and take care not to generate sparks with carelessly handled tools when working on the oxygen system.

1. Keep oxygen regulators, cylinders, gages, valves, fittings, masks and all other components of the oxygen system free of oil, grease, gasoline and all other readily combustible substances.

2. Do not allow foreign matter to enter oxygen lines.

3. Never allow electrical equipment to come in contact with the oxygen cylinder.

4. Never use oxygen from a cylinder without first reducing its pressure through a regulator.

b. Replenishing Oxygen System. U-8D

WARNING

Open all windows and doors to allow escaping oxygen to disperse. Insure that all electrical systems are OFF.

1. Close cylinder shutoff valve.

2. Plug a mask into a distribution outlet.

3. Slowly open the system shutoff valve, which is located on the oxygen console.

4. Adjust regulator to allow oxygen to escape through mask.

5. Close console shutoff valve and set regulator at 0.

WARNING

Do not cap any part of oxygen system with tape.

6. Disconnect cylinder and cap tube assembly with clean metal cap.

7. Remove cylinder from mounting clamps.

8. Secure fully charged cylinder in mounting clamps.

WARNING

Use anti-seize tape MIL-T-27730 only. Do not use an oily compound or sealer under any circumstance.

9. Remove temporary metal cap from tube assembly and connect cylinder.

10. Purge system in accordance with TM 55-1500-204-25/1.

c. Replenishing Oxygen System. U-8G

WARNING

If the oxygen cylinder pressure is below 50 PSI, do not attempt to service system. Make an entry on DA Form 2408-13.

1. Remove protective cap from oxygen cylinder filler valve.

2. Attach oxygen hose from oxygen servicing unit to filler valve.

3. Insure that supply cylinder shutoff valve on the aircraft is open.

4. Fill system slowly, to prevent overheating, by adjusting recharging rate with pressure regulating valve on oxygen servicing unit.

5. Close pressure regulating valve on oxygen servicing unit when cylinder pressure gage on aft bulkhead indicates 1800 psi.

6. Disconnect oxygen hose, from oxygen servicing unit, and from filler valve.

7. Install protective cap on oxygen filler valve.

2-82. Ground Handling.

Ground handling covers all the essential information concerning movement and handling of the aircraft while on the ground. The following paragraphs give, in detail, the instructions and precautions necessary to accomplish ground handling functions.

a. General Ground Handling Procedure. Accidents resulting in injury to personnel and damage to equipment can be avoided or minimized by close observance of existing safety standard and recognized ground handling procedures. Carelessness or insufficient knowledge of the aircraft or equipment being handled can be fatal. The applicable technical manuals and pertinent directives should be studied for familiarization with the aircraft, its components, and the ground handling procedures applicable to it, before attempting to accomplish ground handling.

b. Ground Handling Safety Practice. The following list of safety practices should be observed at all times to prevent possible injury to personnel and/or damaged or destroyed aircraft:

1. Do not operate engines with control surfaces in the locked position.

2. Do not attempt towing or taxiing with control surfaces in the locked position. Do not unlock the control surfaces in high winds until prepared to properly operate them.

3. Do not operate engines while towing equipment is attached or while the aircraft is tied down.

4. Do not run engines at high RPM unless nose wheel is aligned fore and aft.

CAUTION

Use brakes as well as chocks during engine runup.

5. Use approved wheel chocks only.

6. Hold control surfaces in the neutral position when engines are being operated at a high rpm.

CAUTION

Do not set parking brakes when the brakes are hot during low temperatures. An accumulation of moisture may cause the brakes to freeze. Allow brakes to cool before setting parking brakes.

7. The parking brake is not effective unless both the handle and the pilot's pedals have been set. Pull out the handle with only enough force to bring it fully out.

c. Moving Aircraft on Ground. Aircraft on the ground shall be moved in accordance with the following paragraphs:

(1) Taxiing. Aircraft taxiing shall be in accordance with Chapter 8.

(2) Towing. Towing lugs are provided on the upper torque knee fitting on the nose strut. Using a hand tow bar one man can pull the aircraft on level ramp areas. When it is necessary to tow the aircraft with a vehicle, use the vehicle tow bar (figure 2-29). In the event towing lines are necessary, use towing lugs on the main landing gears. Use towing lines long enough to clear the nose and/or tail by not less than 15 feet. This length is required to prevent the aircraft from overrunning the towing vehicle or fouling the nose gear.

CAUTION

Clearance of RU-8D dipole antenna on the wings is approximately 23 inches.

CAUTION

Do not tow aircraft with rudder locks installed, as severe damage to the nose steering linkage can result. When the aircraft is being towed, a qualified person must ride in the pilot's seat to maintain control by use of the brakes. When being towed backwards do not apply the brakes abruptly. Tow the aircraft slowly, avoiding sudden stops, especially over snowy, icy, rough, soggy or muddy terrain. Avoid short radius turns, and always keep the inside of the pivot wheel turning during the operation. In artic climates the aircraft must be towed by the main gears, as an immense breakaway load resulting from ice, frozen tires and stiffened grease in the wheel bearings may damage the nose gear.

d. Ground Handling Under Extreme Weather Conditions. Extreme weather conditions necessitate particular care in ground handling of the aircraft. In hot, dry, sandy desert conditions, extra mooring precautions must be taken. Special

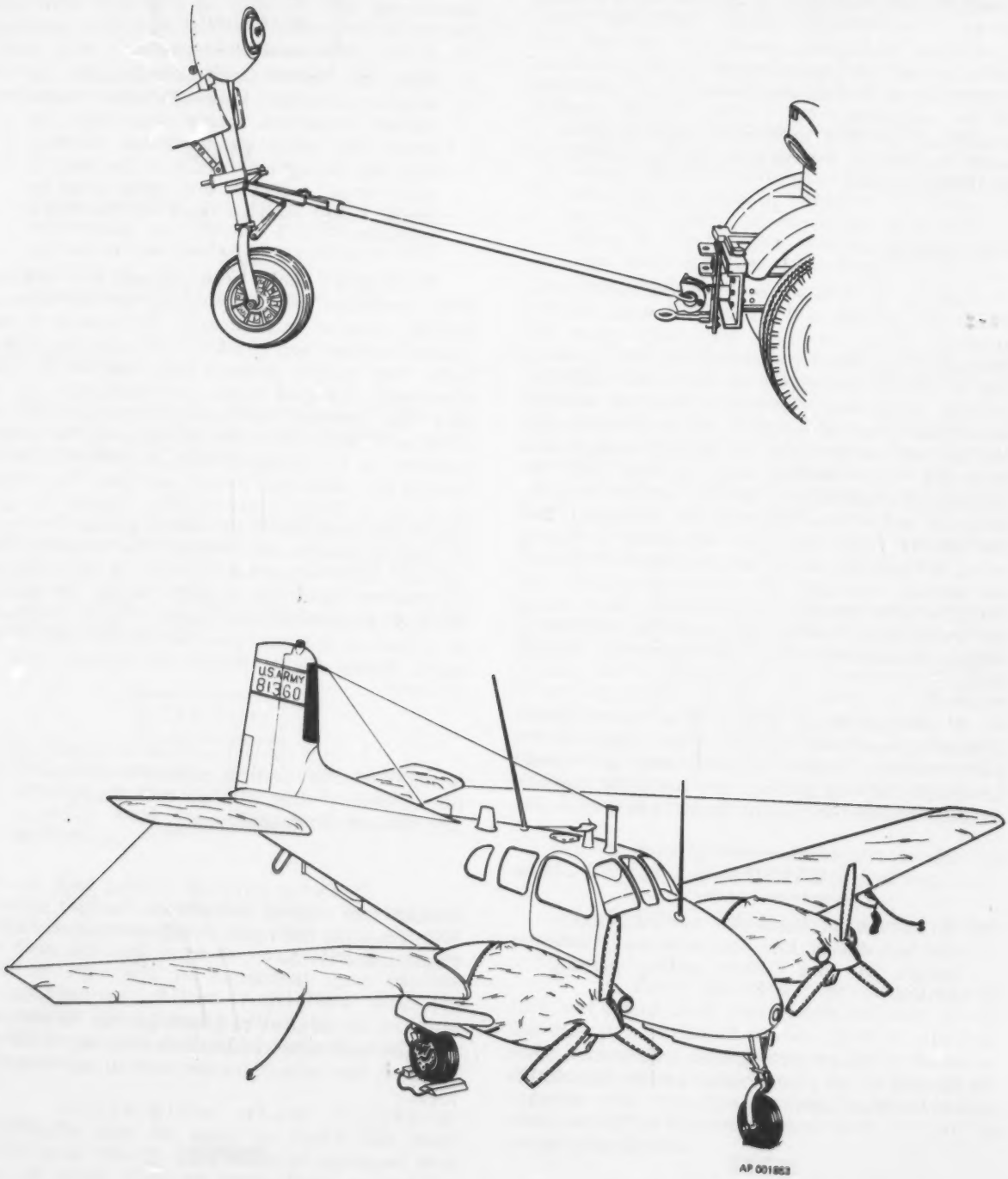


Figure 2-29. Parking, Covers, Ground Handling and Towing Equipment (Typical)

attention must be devoted to finding firmly packed parking or towing areas. If such areas are not available, steel mats or an equivalent solid base must be provided for these purposes. In wet, swampy areas, care must be taken to avoid bogging down the aircraft. Under cold, icy, arctic conditions, additional mooring is required, and added precautions must be taken to avoid skidding during towing operations. The particular problems to be encountered under adverse weather conditions and the special methods designed to avoid damage to the aircraft are covered in TM 55-1500-204-25/1.

2-83. Parking.

Parking is defined as the condition under which the aircraft will be secured while on the ground. This condition may vary from the temporary expedient of setting the parking brake and chocking the wheels to the more elaborate mooring procedure. The proper steps for securing the aircraft must be based on the time the aircraft will be left unattended, the aircraft weight, the expected wind direction and velocity, and the anticipated availability of ground and air crews for mooring and/or evacuation. When practical, head the aircraft into the wind, especailly if strong winds are forecast or if it will be necessary to leave the aircraft overnight. Set the parking brake and chock wheels securely. If extremely heavy winds are anticipated, feather the propellers. Following engine shutdown, position and engage the control locks.

a. Parking Brake System. The parking brake system incorporates two lever type valves, one for each wheel brake. Both valves are closed simultaneously by pulling out the parking brake handle. Operate the parking brake as follows:

CAUTION

Do not set parking brakes when the brakes are hot during low temperatures. Allow brakes to cool before setting parking brakes.

1. To set parking brakes, first press down on the top of the pilot's rudder pedals. This action puts brake fluid under pressure.

NOTE

Parking brake cannot be set by using copilot's brake pedals.

2. Pull out parking handle. Return flow is blocked and pressure is maintained.

3. To release, push in the parking handle.

WARNING

When the control surfaces are caught by wind or propeller blasts sufficient to cause violent movement against their stops, or under any other circumstances whereby they are brought abruptly to the limit of their stops, a special inspection must be made. Entry shall be made on DA Form 2408-13.

b. Control Locks. The control lock (figure 2-21) provides positive locking of the aileron, rudder, elevator and throttles. It consists of the control column and throttle lock, and the rudder lock. The control column and throttle lock isa removable U-shaped frame incorporating a pin to lock the ailerons and elevators at the control column, a bar to lock the throttles in the closed position, and a bungee cord to hold the rudder lock in the raised and locked position. The rudder lock is a frame permanently hinged to the floorboards forward of the rudder pedals. This lock is spring-loaded to rest between the rudder pedals on the floor when not in use. It incorporates notches to hold the rudder pedals in neutral position when raised and locked. The control lock is stowed in the map case on the left wall of the cabin during flight. Install the control lock as follows:

1. Pull control column back until hole in lower part of the control column is exposed. Insert pin in control lock through lock frame hole and into hole of control column.

2. Swing yoke of control lock up and around left side of throttle on control console. With throttles full back, swing crossbar across into position and latch.

3. Brace rudder pedals in neutral position and raise rudder lock to secure pedals in notches; then attach bungee cord to eye on rudder lock.

NOTE

To remove control lock, reverse procedure. Store in map case.

2-84. Installation of Protective Covers.

The aircraft is equipped with a complete set of weatherproof protective covers. The protective covers are provided for protection against frost, ice and snow and shall be installed over the aircraft surfaces, propellers, and components of the aircraft when such weather conditions exist. Cords, tie tapes and zippers are provided for ease of installation and removal.

NOTE

Before installing protective covers under subfreezing conditions, prepare aircraft surfaces to be covered in accordance with anti-icing, deicing and defrosting treatment outlined in paragraph 2-78.

2-85. Mooring.

The aircraft is moored to insure its immovability, protection, and security under various weather conditions.

a. Mooring Procedure. Mooring points (figure 2-30) are provided beneath the wing, nose and tail and on each main landing gear. General mooring equipment and procedures necessary to moor the aircraft in addition to the following are provided by TM 55-1500-204-25/1.

CAUTION

Do not use slip knots. Use square, bowline, or some other equally reliable anti-slip knot to insure a firm, safe anchoring.

1. Use mooring cables of 1/4-inch aircraft cable-and-clamp (clip-wire rope), or not less than 3/8-inch rope or chain. Length of the cable or rope will be dependent upon existing circumstances. Allow sufficient slack to compensate for tightening action due to moisture absorbtion of rope or thermal contraction of cable or chain.

2. One-piece wheel chocks or woodblocks may be used to chock the main landing gear wheels. They must be equipped with rope or wood cleats to retain them against the wheels.

NOTE

Collapsible ice grip wheel chocks should be used in ice or snow. Use sandbags if aircraft is parked on steel mats, or if collapsible chocks are unavailable.

CAUTION

Structural damage can occur from high velocity winds. If at all possible, the aircraft should be moved to a safe weather area when a tornado, hurricane, typhoon, or winds above 75 knots are expected. When an aircraft has been subjected to high wind velocities make an entry on DA Form 2408-13.

b. Mooring Procedure for High Winds. If an aircraft is to remain securely moored during high velocity winds, it is necessary to use the proper size and type of wheel chock. Since the factor of weight is significant in determining the adequate mooring provisions, the approximate weight must be known. The design gross weight of the U-8D is 7300 pounds; of the U-8G and RU-8D 7350 pounds. It is also well to keep in mind the variation in aircraft weight due to the amount of cargo.

1. After aircraft is properly located, place nose wheel in fore and aft position. Head aircraft into the wind, or as nearly so as possible within limits determined by locations of fixed mooring rings. When necessary, a 45-degree variation of direction is considered to be satisfactory. Locate the aircraft at slightly more than wing span distance from all other aircraft. Position nose mooring point approximately 3 to 5 feet downwind from ground mooring anchors.

2. Deflate nose wheel shock strut to within 3/4 inch of its fully deflated position.

3. Fill all fuel tanks to capacity if time permits.

4. Place approved type wheel chocks fore and aft of main gear wheels and nose wheel. Tie each pair of chocks (wood) together with rope or join together with wooden cleats nailed to chocks on either side of wheels. Tie ice grip chocks together with rope. Use sandbags in lieu of chocks when aircraft is moored on steel mats. Set parking brake as applicable.

5. Accomplish aircraft tiedown by utilizing mooring points. Make tiedown with 1/4

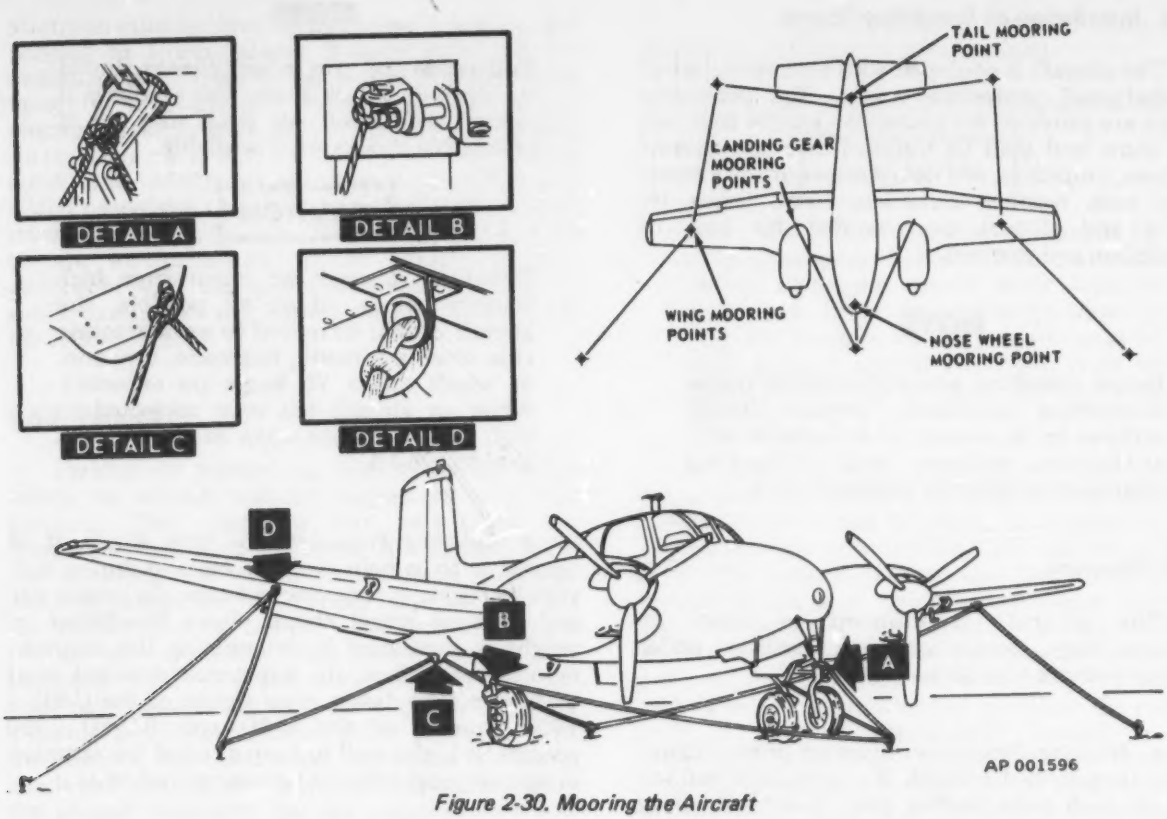


Figure 2-30. Mooring the Aircraft

inch aircraft cable, using two wire rope clips, or bolts, and a chain tested for a 3000 pound pull. Attach tiedowns so as to remove all slack. (Use a 3/4 inch or larger manila rope if cable or chain tiedown is not available.) If rope is used for tiedown, use anti-slip knots, such as bowline knot, rather than slip knots. In the event tiedown rings are not available on hard surfaces area, move aircraft to an area where portable tiedowns can be used. Locate anchor rods at points shown in figure 2-30. When anchor kits are not available, use metal stakes or dead-man type anchors, providing they can successfully sustain a minimum pull of 3000 pounds.

6. In the event nose position tiedown is considered to be of doubtful security due to existing soil condition, drive additional anchor rods expressly at nose tiedown position. Place padded work stand or other suitable support under the aft fuselage tiedown position and secure.

7. Place control surfaces in locked position and trim tab controls in neutral position. Place wing flaps in up position.

8. The requirements for dust excluders, protective covers, and taping of openings will be left to the discretion of the responsible maintenance officer or the pilot of the transient aircraft.

9. Secure propellers to prevent windmilling.

10. Disconnect battery(s).

NOTE

Where typhoon conditions exist, it is well to remember that the storm appears to pass two times, each time with a different wind direction. This will necessitate turning the aircraft after the first passing.

11. During typhoon wind conditions, mooring security can be further increased by placing sandbags along the wings to break up the aerodynamic flow of air over the wing, thereby reducing the lift being applied against the mooring by the wind.

12. After high winds, inspect aircraft for visible signs of structural damage and for evidence of damage from flying objects. Service nose shock strut and reconnect battery(s).

CHAPTER 3
AVIONICS

Section I. GENERAL

3-1. Introduction.

This chapter covers the electronic equipment configuration installed in Army Aircraft U-8D, U-8G and RU-8D. It includes a brief description of the electronic equipment, its technical characteristics, capabilities, and location. The chapter also contains complete operating instructions for all signal equipment installed in the aircraft.

NOTE

Transmission on emergency frequencies (guard channel) shall be restricted to emergencies only.

3-2. Electronic Equipment Configuration.

The electronic configuration of the U-8D, RU-8D and U-8G aircraft is comprised of three groups of electronic equipment. The communication equipment group consists of the interphone, FM liaison, UHF command, VHF command, and HF command systems. In addition the RU-8D and U-8D are equipped with an emergency VHF transmitter. The navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach under Instrument Flight Rules (IFR) conditions. The navigation group includes equipment for determining altitude, attitude, position, destination range and bearing, heading reference, groundspeed, and drift angle. A doppler navigation system is installed within the navigation group of the RU-8D aircraft. The transponder and radar group includes an identification, position and emergency tracking system.

3-3. Power Supply.

DC power for the avionics equipment is provided from the 28 volt DC-battery bus. In U-8D aircraft, AC power is provided from inverters to operate gyro compass indicator, the glide slope receiver, the TACAN, and 26 volt AC navigation indicator transformer (when installed). Inverters provide AC power in U-8G aircraft to operate the gyro magnetic compass, the gyrosyn compass indicator, the glide slope receiver and its controls, the TACAN and the ID-663 bearing, distance and heading indicator. RU-8D aircraft use inverters to provide AC power to operate the glide slope receiver, attitude indicator, doppler, C12 compass and the 26 volt AC compass excitation transformer. External DC power can be supplied to the aircraft through a receptacle, located on the outboard side of the left engine nacelle.

Section II. COMMUNICATIONS

3-4. Description.

The communications equipment group consists of the FM liaison set, UHF command set, VHF command set, and HF command set. All aircraft have interphone facilities. U-8D and RU-8D aircraft are equipped with a VHF emergency transmitter.

3-5. Microphone Switches.

a. Description. A microphone switch is installed on each control wheel, placarded MIC KEY and on the floorboard in front of each pilot's seat, placarded MIC.

b. Microphone Switch Functions.

CONTROL	FUNCTION
MIC KEY switch	Keys the transmitter or interphone facility selected by the transmitter-selector on the respective audio control panel.
MIC switch	When pressed, keys the facility selected by the transmitter-interphone selector on the respective audio control panel.

3-6. Interphone System.

The interphone system consists of the control panels and associated wiring.

a. Audio Control Panels (SB-329). U-8D STD Individual audio control panels are provided for the pilot and copilot. The controls and switches on each panel provide for reception and volume control of interphone, communication, and navigation audio signals. In addition, a choice of transmission over assigned FM, UHF or VHF pre-selected channels is available. Figure 3-1 illustrates the audio control panel. The interphone system is protected by a circuit breaker switch, placarded INT-FM located on the right subpanel.

(1) Audio control panel switch functions (figure 3-1).

CONTROL	FUNCTION
RECEIVERS - 1 switch	Up position applies pilots' FM receiver audio to the headset.
RECEIVERS - 2 switch	Up position applies UHF receiver audio to the headset.
RECEIVER - 3 switch	Up position applies VHF audio to the headset.
Transmitter - interphone selector	Determines operating mode:
INT	Selects interphone communication.
1	Selects FM transmitter.
2	Selects UHF or HF transmitter (depending on position of command transmitter selector switch, para. 3-8).
3	Selects VHF transmitter.
RECEIVERS - NAV switch	Up position applies VOR and ADF audio to the headset.
RECEIVERS - MB switch	Up position applies marker beacon audio to the headset.
VOL control	Adjusts audio volume.

(2) Audio control panel operation.

(a) Turn-on procedure: The audio control panels are on whenever electrical power is applied to the aircraft.

(b) Interphone operation procedure:

1. Transmitter-interphone selector — INT.

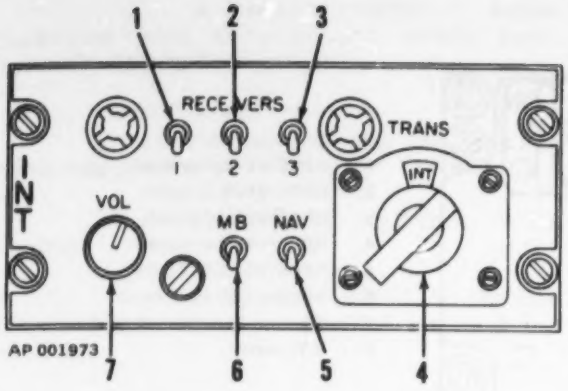
2. Microphone switch — Press (listen for sidetone).

3. Volume control — adjust for comfortable audio level.

(c) Navigational aid and receiver monitoring procedure:

1. Receiver switches — As required.

2. Volume control — Do not disturb. Adjust volume control of system being monitored.



1. RECEIVERS-1 switch
2. RECEIVERS-2 switch
3. RECEIVERS-3 switch
4. Transmitter-Interphone selector
5. RECEIVERS-NAV switch
6. RECEIVERS-MB switch
7. VOL control

Figure 3-1. Audio Control Panel (SB-329)

(d) Transmitting procedure:

1. Transmitter - interphone selector — As required.

2. XMTR (command transmitter selector) switch — As required.

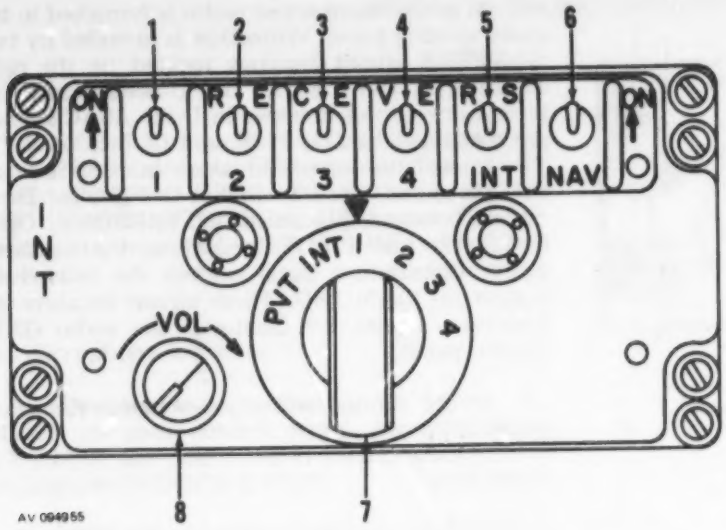
3. Microphone switch — Press (listen for sidetone).

4. Applicable transceiver volume control — Adjust for comfortable audio level.

b. Audio Control Panels (C-1611). U-8D ASAC U-8G RU-8D. The intercommunication set controls (figure 3-2) are installed as follows: one for the pilot, one for the copilot, and one (RU-3D only) for the mission system operator. Each interphone control consists of four RECEIVERS switches, an INT switch, a NAV switch, a VOL control, and transmit-interphone selector switch. A functional instruction plate, installed beside the interphone control, described the function of the control switches. The audio output of the transponder is fed directly through the audio control panel into the headsets. No control of the transponder audio is furnished in the audio control panel. Protection is provided by two 5-AMPERE circuit breakers located on the right subpanel in U-8D ASAC and U-8G aircraft. The interphone circuit breakers in U-8D ASAC aircraft are placarded PILOT INPH and COPILOT INPH. The interphone circuit breakers in U-8G aircraft are placarded PILOT INPH COPILOT. Three circuit breakers, placarded INTERPHONE, OPR, COPILOT, and PILOT located on the overhead power distribution panel protect the interphone system on the RU-8D. These circuit breakers are 5-ampere. Figure 3-2 illustrates the audio (INT) control panel.

(1) Audio control panel switch functions (figure 3-2).

CONTROL	FUNCTION
RECEIVERS - 1 switch	ON position applies FM receiver audio to the headset.
RECEIVERS - 2 switch	ON position applies UHF receiver audio to the headset.
RECEIVERS - 3 switch	ON position applies VHF receiver audio to the headset.
RECEIVERS - 4 switch	ON position applies HF receiver audio to the headset.
RECEIVERS - INT switch	ON position applies interphone audio to the headset.
RECEIVERS - NAV switch	ON position applies navigation receiver audio to headset.
Transmitter - interphone selector	Determines operating mode:
PVT	Applies hot-mike feature to interphone communication for the pilot and copilot.
INT	Selects interphone communication.
1	Selects FM transmitter.
2	Selects UHF transmitter.
3	Selects command VHF transmitter.
4	Selects HF transmitter.
VOL control	Adjusts audio volume.



1. RECEIVERS-1 switch
2. RECEIVERS-2 switch
3. RECEIVERS-3 switch
4. RECEIVERS-4 switch
5. RECEIVERS-INT switch
6. RECEIVERS-NAV switch
7. Transmitter interphone selector
8. VOL control

Figure 3-2. Audio Control Panel (C-1611/A1C)

(2) Audio control panel switch functions (figure 3-2).

CONTROL	FUNCTION
RECEIVERS - 1 switch	ON position applies FM receiver audio to the headset.
RECEIVERS - 2 switch	ON position applies UHF/VHF receiver audio to the headset.
RECEIVERS - 3 switch	ON position applies HF receiver audio (bottom receiver at mission operator position) to the headset.
RECEIVERS - 4 switch	ON position applies emergency VHF receiver audio (top receiver at mission operator position) to the headset.
RECEIVERS - INT switch	ON position applies interphone audio to the headset.
RECEIVERS - NAV switch	ON position applies navigation receiver audio to the headset.
Transmitter - interphone selector	Determines operating mode:
PVT	Applies hot-mike feature to interphone communication for the pilot and copilot.
INT	Selects interphone communication.
1	Selects FM transmitter.
2	Selects UHF/VHF transmitter. Not used at mission operator position.
3	Selects HF transmitter. Not used at mission operator position.
4	Selects emergency VHF transmitter. Not used at mission operator position.
VOL control	Adjusts audio volume.

(3) Audio control panel operation.

(a) Turn-on procedure: Audio control panel is on whenever electrical power is applied to the aircraft.

(b) Interphone operation procedure:

1. Transmitter-interphone selector — INT.

2. Microphone switch — Press (listen for sidetone).

3. Volume control — Adjust sidetone and interphone audio level (approximately half volume).

(c) Navigational aid and receiver monitoring procedure:

1. Receiver switches — As required.

2. Volume control — Do not disturb. Adjust volume control of system being monitored.

(d) Transmitting procedure:

1. Transmitter - interphone selector — As required.

2. Microphone switch — Press (listen for sidetone).

3. Applicable transceiver volume control — Adjust for comfortable audio level.

3-7. Emergency Transmitter Selector Switches. U-8D STD

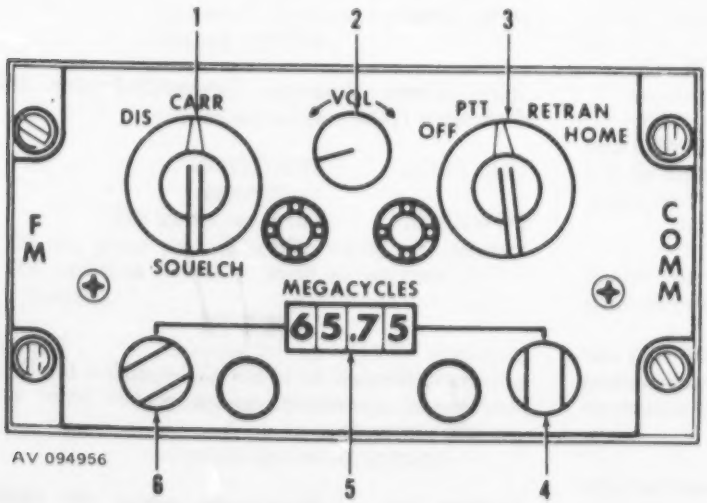
The emergency transmitter selector switches (figure 2-26) serve as the transmitter selector switch when operating on the emergency communication system. An emergency transmitter selector switch is located on each end of the instrument panel and is placarded EMERGENCY XMTR UHF-VHF.

3-8. Command Transmitter Selector Switch. U-8D STD

The command transmitter selector switch (figure 2-26) placarded XMTR, provides manual selection of the transmitter to be used when the transmitter interphone selector on the audio control panel is set to position 2 (main communications). When the command transmitter selector switch is in the UHF-VHF position, the microphone audio from both interphone positions will be routed to the UHF command set transmitter. When this switch is in the HF position, microphone audio will be routed to the HF command set.

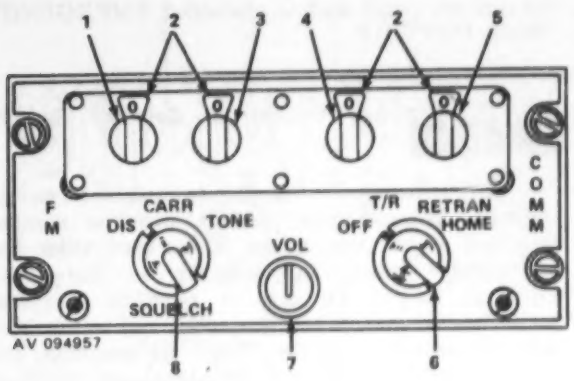
3-9. FM Liaison Set (AN/ARC-54 or AN/ARC-131).

The FM liaison set is a radio transceiver which provides two-way frequency modulated (FM) communications in the 30.00 to 69.95 MHz (75.95 AN/ARC-131) range for a distance of approximately 50 miles. The FM liaison set is used for voice communications. The audio output is applied to the respective audio control panel where it is made available to the headsets. The FM liaison set is protected by the 15-ampere ARC-54 circuit breaker on the right subpanel. Figures 3-3 and 3-4 illustrate the FM (FM COMM) liaison set control panels. The associated antenna is shown in figure 2-1, 2-2, or 2-3.



1. SQUELCH switch
2. VOL control
3. Mode selector
4. Kilohertz selector
5. Frequency indicator
6. Megahertz selector

Figure 3-3. FM Control Panel (AN/ARC-54)



1. Megahertz (10) selector
2. Frequency indicator
3. Megahertz (1) selector
4. Kilohertz (100) selector
5. Kilohertz (10) selector
6. Mode selector
7. VOL control
8. SQUELCH switch

Figure 3-4. FM Control Panel (AN/ARC-131)

NOTE

An Aircraft may have Radio Set AN/ARC-131 installed in lieu of the AN/ARC-54. The ARC-131 is similar to the ARC-54, except that the frequency range is 30.00-75.95 megahertz.

a. FM Control Panel Switch Functions (figure 3-3 or 3-4).

CONTROL	FUNCTION
Megahertz selector	Tunes transceiver in 10-MHz and 1-MHz steps as indicated by the first two digits of the frequency indicator.
Frequency indicator	Indicates frequency to which transceiver is tuned.
Kilohertz selector	Tunes transceiver in 100-kHz and 50-kHz steps as indicated by last two digits of the frequency indicator.
Mode selector	Determines operating mode:
OFF	Turns set off.
T/R (ARC-131) PTT (ARC-54)	Provides . transceiver operation of frequency displayed on frequency indicator.
RETRAN	Not used in this installation.
HOME	Not used in this installation.
VOL control	Adjusts volume.
SQUELCH switch	
DIS	Disables receiver squelch circuit.
CARR	Activates receiver squelch circuits.
TONE (AN/ARC-131)	Disables receiver squelch circuits during reception of ciphered communications.

b. FM Liaison Set Operation. (Refer to paragraph *3-10).*

3-10. Voice Security System, (TSEC/KY-28).

U-8D ASAC | U-8G | RU-8D

This system can be used in conjunction with the FM liaison set to provide secure (ciphered) two-way voice communication. Refer to TM 11-5821-244-12. The U-8D ASAC and U-8G voice security systems are protected by the 5-ampere KY 28 circuit breaker on the right subpanel. The RU-8D voice security system is protected by a 5-ampere KY 28 circuit breaker on the overhead power panel.

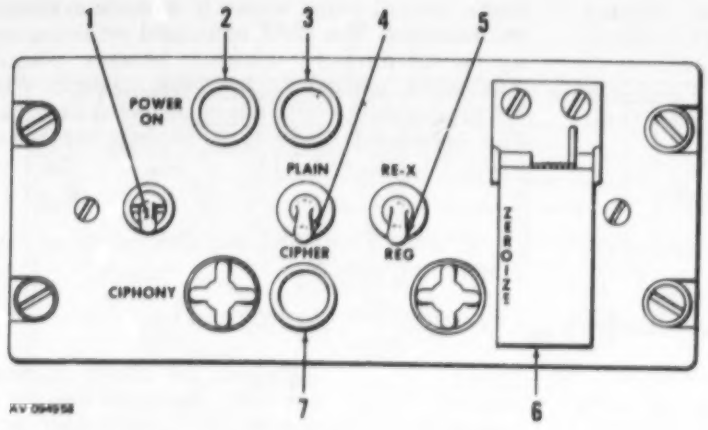
a. Voice Security Control-Indicator Switch Functions (figure 3-5).

CONTROL	FUNCTION
POWER ON switch	Turns set on or off.

NOTE

Switch must be in the ON position for FM liaison operations in either the plain or cipher mode.

POWER ON indicator	Illuminates when the POWER ON switch is placed in the on (up) position.



1. POWER ON switch
2. POWER ON indicator
3. PLAIN indicator
4. PLAIN-CIPHER switch
5. RE-X-REG switch
6. ZEROIZE switch
7. CIPHER indicator

Figure 3-5. Voice Security Control-Indicator (C-8157/ARC)

PLAIN indicator — Illuminates when the PLAIN/CIPHER switch is in the PLAIN position.

PLAIN/CIPHER switch

PLAIN — Permits unciphered communications.

CIPHER — Permits ciphered communications.

RE-X/REG switch

RE-X — Permits retransmission of ciphered communications at a distant location.

REG — Permits normal cipher or plain communications.

NOTE

Do not place the ZEROIZE switch in the ON position unless a crash or capture is imminent.

ZEROIZE switch — Normally in OFF position. Placed in ON position during emergency situations to neutralize and make inoperative the associated cipher equipment.

CIPHER indicator — Illuminates when the PLAIN/CIPHER switch is in the CIPHER position.

b. FM Liaison Set and Voice Security System Operation.

NOTE

Disregard the operating procedures involving the voice security (CIPHONY) control-indicator if this unit is not installed.

(1) Turn-on procedure: POWER ON switch (CIPHONY control-indicator, figure 3-5) — on.

NOTE

The POWER ON switch must be in the on position, regardless of the mode of operation, whenever the voice security (CIPHONY) control-indicator is installed in the aircraft.

(2) Receiver operating procedure:

1. SQUELCH switch (FM COMM control panel, figure 3-3 or 3-4) — As required.

2. Mode selector (FM COMM control panel) — PTT (T/R on AN/ARC-131 control).

3. Frequency selectors (FM COMM control panel) — As required.

(3) Transmitter operating procedure (PLAIN):

1. Transmitter-interphone selector (audio control panel, figure 3-1 or 3-2) — No. 1 position.

2. PLAIN/CIPHER switch (CIPHONY control-indicator) — PLAIN.

3. Microphone switch — Press.

(4) Transmitter operating procedure (CIPHER):

1. Transmitter-interphone selector (audio control panel) — No. 1 position.

2. PLAIN/CIPHER switch (CIPHONY control-indicator) — CIPHER. (CIPHER indicator will be on as long as switch is in CIPHER position.)

3. RE-X/REG switch (CIPHONY control-indicator) — As required. (RE-X position only if distant station is using retransmitting equipment.)

4. Microphone switch — Press momentarily (interrupted tone from voice security unit should no longer be heard.

NOTE

No traffic will be passed if the interrupted tone is still heard from pressing and releasing the microphone switch.

5. Microphone switch — Press (do not talk). Wait until beep is heard, then speak into microphone.

(5) Shutdown procedure:

1. Mode selector (FM COMM control panel) — OFF.

2. POWER ON switch (CIPHONY control-indicator) — OFF.

3-11. UHF Command Set (AN/ARC-51BX).

The UHF command set provides two-way amplitude modulated (AM) voice communication within the frequency range of 225.0 to 399.95 MHz for a distance range of approximately 50 miles line-of-sight. Channel selection is spaced at 50 kHz intervals. Additionally, a separate receiver is incorporated to provide monitoring capability for the UHF guard frequency (243.0 MHz). The audio output of the UHF set is applied to the audio control panel where it is made available to the headsets. The UHF command set is protected by a 15-ampere circuit breaker placarded ARC-51BX located on the right subpanel. Figure 3-6 illustrates the UHF command set control panel. The associated blade type antenna is shown in figure 2-1, 2-2, or 2-3.

a. UHF Command Set Control Panel Switch Functions (figure 3-6).

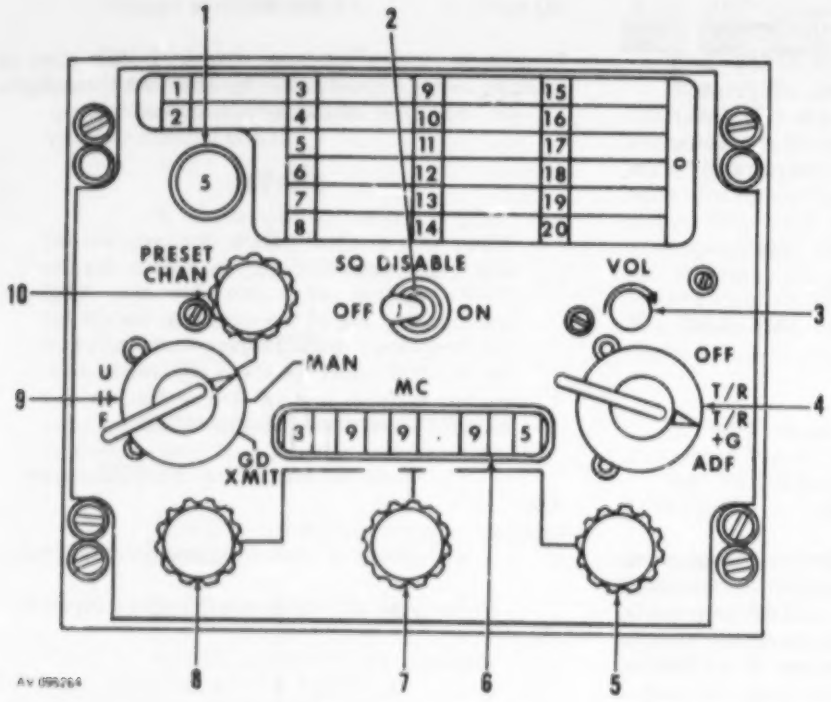
CONTROL	FUNCTION
Preset channel indicator	Indicates the preset channel in use when the mode selector is in the PRESET CHAN position.
SQ DISABLE switch	Turns squelch circuit on or off.
VOL control	Adjusts volume.
Function switch	Selects type of operation and turns set off.
Manual frequency selector	Selects the operating frequency when the mode selector is in the MAN position.
Frequency indicator	Indicates the operating frequency of the UHF receiver and transmitter when the mode selector is in the MAN position.
Mode selector	Determines operating mode:
PRESET CHAN	Permits selection of one of 20 preset channels.
MAN	Permits frequency selection by means of manual frequency selector controls.
GD XMIT	Automatically tunes to the guard channel frequency.
PRESET CHAN selector	Selects the desired preset channel when the mode selector is in the PRESET CHAN position.

b. UHF Command Set Operation.

(1) Turn-on procedure: Function switch (UHF control panel) — T/R + G.

(2) Receiver operating procedure:

1. Mode selector — As required.



1. Preset channel indicator
2. SQ DISABLE switch
3. VOL control
4. Function switch
5. Manual (decimal) frequency selector
6. Frequency indicator
7. Manual (1 MHz) frequency selector
8. Manual (10 MHz) frequency selector
9. Mode selector
10. PRESET CHAN selector

Figure 3-6. UHF Control Panel (AN/ARC-51 BX)

2. Frequency — Select required frequency using either preset channel selector or manual frequency selector.

NOTE

The PRESET CHAN selector and frequency selectors are all inoperative when the mode selector is set to GD XMIT position.

3. Volume — Adjust.

NOTE

To adjust volume when audio is not being received, turn squelch disable switch ON, adjust volume for comfortable noise level, then turn squelch disable switch OFF.

4. Squelch — As required.

(3) Transmitter operating procedure:

1. Transmitter-interphone selector (audio control panel, figure 3-1 or 3-2) — No. 2 position.

2. Microphone switch — Press.

(4) Shutdown procedure: Function switch — OFF.

c. UHF Command Set Emergency Operation.

NOTE

Transmission on emergency frequencies (guard channel) shall be restricted to emergencies only. An emergency frequency of 121.500 MHz is also available on the VHF command radio set.

1. Transmitter-interphone selector (audio control panel, figure 3-1 or 3-2) — No. 2 position.

2. Mode selector (UHF control panel) — GD XMIT.

NOTE

The PRESET CHAN selector and frequency selectors are all inoperative when the mode selector is set to GD XMIT position. The receiver-transmitter will be set to 243.00 MHz (emergency frequency).

3. Microphone switch — Press.

3-12. VHF Command Set (AN/ARC-73).

RU-8D

NOTE

Provisions for the AN/ARC-73 are provided in the U-8D aircraft.

The VHF command set provides the operator with two way voice communication within a frequency range of 116.00 to 149.95 megahertz. The transmitter of the VHF command set may be operated within a frequency range of 116.00 to 149.95 megahertz. The receiver may be tuned within a frequency range of 116.00 to 151.95 megahertz. The range of the VHF command set is limited to line of sight up to distances of approximately 50 miles. The VHF command set is protected by the 5-ampere VHF XMTR circuit breaker on the right subpanel. Figure 3-7 illustrates the VHF (VHF COMM) command set control panel. The associated blade type antenna is shown in figure 2-1, 2-2, or 2-3.

a. VHF Command Set Control Panel Switch Functions (figure 3-7).

CONTROL	FUNCTION
POWER switch	
ON	Turns set on.
OFF	Turns set off.
Frequency indicator	Indicates the operating frequency.
Kilohertz selector	Tunes receiver in 50 kHz steps as indicated by the last two digits of the frequency indicator.
Mode selector	Not used in this installation.
VOL control	Adjust volume.
SQ control	Adjusts receiver squelch.
Megahertz selector	Tunes receiver in 1 MHz steps as indicated by the first three digits of the frequency indicator.

NOTE

When two control panels are installed for this VHF command set, one will be for the VHF receiver and one for the VHF transmitter. All of the controls, except for the frequency selectors, are inoperative on the control panel for the VHF transmitter.

b. VHF Command Set Operation.

(1) Turn on procedure: POWER switch — ON.

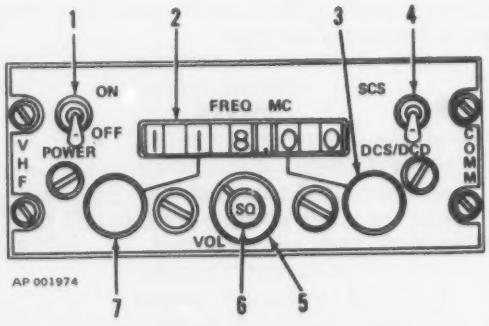
(2) Receiver operating procedure:

1. INT FM switch (right subpanel) — ON.

2. XMTR selector switch (instrument panel) — UHF-VHF.

3. RECEIVERS switch No. 3 (audio control panel) — ON.

4. POWER switch — ON.



1. POWER switch
2. Frequency indicator
3. Kilohertz selector
4. Mode selector
5. VOL control
6. SQ control
7. Megahertz selector

Figure 3-7. VHF Control Panel (AN/ARC-73)

NOTE

On aircraft which have a receiver control panel and a transmitter control panel, the power switch is operative only on the receiver control panel.

5. Mode selector switch — SCS.

6. Frequency selectors — As required.

NOTE

On aircraft which have a receiver control panel and a transmitter control panel, frequency selection must be accomplished on both panels.

7. VOL control (audio control panel) — mid position.

8. SQ control — As required.

9. VOL control — As required.

(3) Transmitter operating procedure.

1. Transmitter-interphone selector (audio control panel) — No. 3 position.

2. Frequency selectors (transmitter control panel when installed) — As required.

3. Microphone switch — Press.

(4) Shutdown procedure: POWER switch — OFF.

c. VHF Command Set Emergency Operation.

NOTE

Emergency frequency is available on UHF transmitter also (243.00 MHz). Transmission on emergency frequency (121.500 or 243.00 MHz) shall be restricted to emergencies only.

1. Transmitter-interphone selector (audio control panel, figure 3-1 or 3-2) — No. 3 position.

2. Frequency selector (VHF control panel) — 121.500 MHz (emergency frequency).

3. Microphone switch — Press.

3-13. VHF Command Set (AN/ARC-134). U-8G U-8D U-8D ASAC

The VHF command set is a line-of-sight radio transceiver which provides transmission and reception of amplitude-modulated signals in the very high frequency range of 116.000 to 149.975 MHz for a distance range of approximately 50 miles. The VHF command set is protected by a 15-ampere circuit breaker placarded VHF located on the right subpanel. Figure 3-8 illustrates the VHF (VHF COMM) command set control panel. The associated blade type antenna is shown in figure 2-1, 2-2, or 2-3.

a. VHF Command Set Control Panel Switch Functions (figure 3-8).

CONTROL	FUNCTION
Frequency indicator	Indicates the operating frequency.
COMM TEST switch	Disables VHF receiver squelch circuits to permit reception of low-level communication signals or a test for receiver audio.
VOL control	Adjusts volume.
Frequency selector	Selects the operating frequency.
PWR switch	Turns set on or off.

b. VHF Command Set Operation.

(1) Turn on procedure: Power switch — PWR.

(2) Receiver operating procedure:

1. Frequency selector — Select.

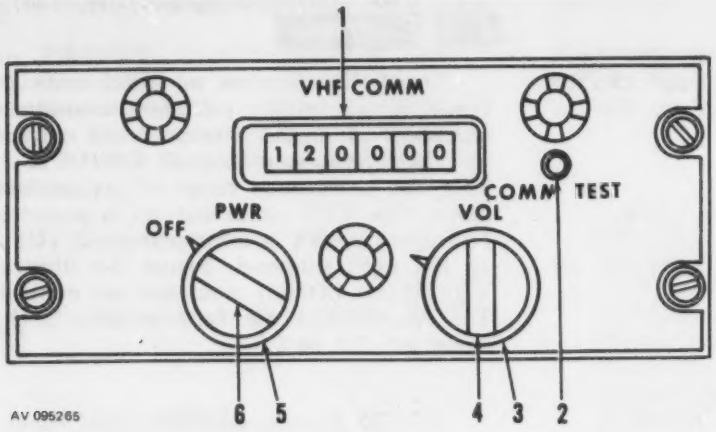
2. VOL control — As required.

(3) Transmitter operating procedure:

1. Transmitter-interphone selector (audio control panel, figure 3-1 or 3-2) — No. 3 position.

2. Microphone switch — Press.

(4) Shutdown procedure: Power switch — OFF.



1. Frequency indicator
2. COMM TEST switch
3. VOL control
4. Frequency (kHz) selector
5. PWR switch
6. Frequency (MHz) selector

Figure 3-8. VHF Control Panel (AN/ARC-134)

c. VHF Command Set Emergency Operation.

NOTE

Emergency frequency is available on UHF transmitter also (243.00 MHz). Transmission on emergency frequency (121.500 or 243.00 MHz) shall be restricted to emergencies only.

1. Transmitter-interphone selector (audio control panel, figure 3-1 or 3-2) — No. 3 position.

2. Frequency selector (VHF control panel) — 121.500 MHz (emergency frequency).

3. Microphone switch — Press.

3-14. HF Command Set (AN/ARC-102).

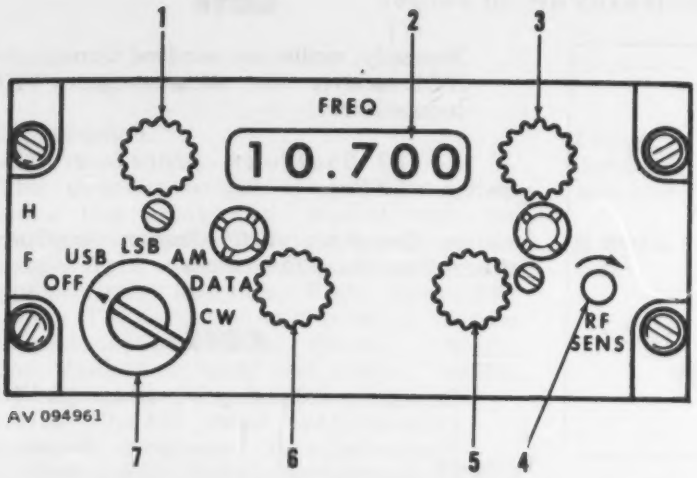
NOTE

Provisions only are installed for the HF command set in U-8D, U-8G and U-8D ASAC aircraft.

The HF command set provides long-range voice communications within the frequency range of 2.000 to 29.999 MHz. The HF command set employs either standard amplitude-modulation (AM), lower sideband (LSB) modulation, or upper sideband (USB) modulation. The distance range of the HF command set is approximately 2,500 miles, and varies with altitude. The HF command set in U-8D aircraft is protected by a 50-ampere ARC-102 circuit breaker located on the right subpanel. The HF command set in U-8G and RU-8D aircraft is protected by a 5-ampere HF CONT circuit breaker and a 50-ampere ARC-102 circuit breaker located below the right subpanel. Figure 3-9 illustrates the control panel for the HF command set. The associated antenna is shown in figure 2-1, 2-2, or 2-3.

a. HF Control Panel Switch Functions (figure 3-9).

CONTROL	FUNCTION
Frequency selector	Selects the operating frequency.
FREQ indicator	Indicates operating frequency.
REF SENS control	Adjusts volume.
Mode selector	Determine operating mode:
OFF	Turns set off.
USB	Selects upper sideband modulation.
LSB	Selects lower sideband modulation.



1. Frequency (MHz) selector
2. FREQ indicator
3. Frequency (1-kHz) selector
4. RF SENS control
5. Frequency (10-kHz) selector
6. Frequency (100-kHz) selector
7. Mode selector

Figure 3-9. HF Control Panel (AN/ARC-102)

AM	Selects amplitude modulation.
DATA	Not used in this installation.
CW	Upper sideband transmissions are modulated with a 1000 Hz tone.

b. HF Command Set Operation.

(1) Turn-on procedure: Mode selector — As required.

(2) Receiver operating procedure:

1. Frequency selector — Select.

2. RF SENS control — Adjust for barely audible background noise.

(3) Transmitter operating procedure:

1. Transmitter-interphone selector (audio control panel, figure 3-1 or 3-2) — No. 4 position.

2. Microphone switch — Press.

(4) Shutdown procedure: Mode selector — OFF.

3-15. Emergency VHF Transmitter. U-8D STD RU-8D

The emergency VHF transmitter (T-366( )/ARC) is provided for use as an emergency VHF communication system using the VOR receiver as a VHF receiver. There are five available channels provided by this transmitter. Emergency interphone is also provided by this transmitter. The range is limited to line of sight up to distances of approximately 50 miles.

a. Emergency VHF Transmitter Control Panel Switch Functions (figure 3-10).

CONTROL	FUNCTION
Function switch	Determines operating mode:
OFF	Turn set off.
STBY	Selects standby position.
Frequency positions	Select desired frequency.

b. Emergency VHF Transmitter Operation.

(1) Turn on procedure: Function switch — STBY or frequency required.

(2) Transmitter operating procedure:

1. INT FM switch — ON.

2. NAV RECEIVER switch (audio control panel) — ON.

3. Emergency transmitter selector switch (instrument panel) — Up.

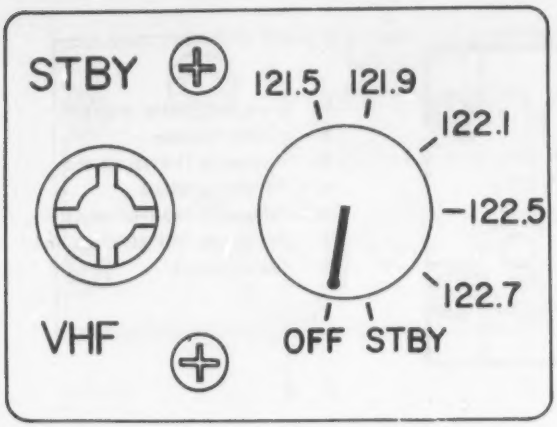


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Figure 3-10. Emergency VHF Transmitter Control Panel (T-366( )/ARC)

4. Function switch — Required frequency.

5. Transmitter-interphone selector (audio control panel) — No. 3 position.

6. Microphone switch — Press.

NOTE

Normally, replies are received through the VOR receiver when using emergency VHF transmitter.

(3) Shutdown procedure: Function switch — OFF.

c. Emergency VHF Transmitter Operation Under Emergency Conditions.

NOTE

Emergency frequency is available on UHF transmitter also (243.00 MHz). Transmission on emergency frequency (121.500 or 243.00 MHz) shall be restricted to emergencies only.

1. Transmitter-interphone selector (audio control panel, figure 3-1 or 3-2). — No. 3 position.

2. Frequency selector (emergency VHF control panel) — 121.500 MHz (emergency frequency).

3. Microphone switch — Press.

NOTE

Normally, replies are received through VOR receiver when using emergency VHF transmitter.

Section III. NAVIGATION

3-16. Description.

The overall navigation equipment group provides the pilot and copilot with the instrumentation required to establish and maintain an accurate flight course and position and to make an approach under Instrument Flight Rules (IFR) conditions. The navigation configuration includes equipment for determining altitude, attitude, position, destination range and bearing, heading reference, groundspeed, and drift angle.

3-17. Electronic Equipment Configuration. U-8D U-8D ASAC

Three navigation configurations are available in the U-8D and U-8D ASAC aircraft. One of the following navigation system configurations will be installed:

a. One Radio Receiving Set AN/ARN-30E, one Direction Finder Set AN/ARN-59 (ADF No. 1), and one Direction Finder Set AN/ARN-59 (ADF No. 2).

b. One Radio Receiving Set AN/ARN-30E (OMNI No. 1), one Radio Receiving Set AN/ARN-30D (OMNI No. 2) and one Direction Finder Set AN/ARN-59.

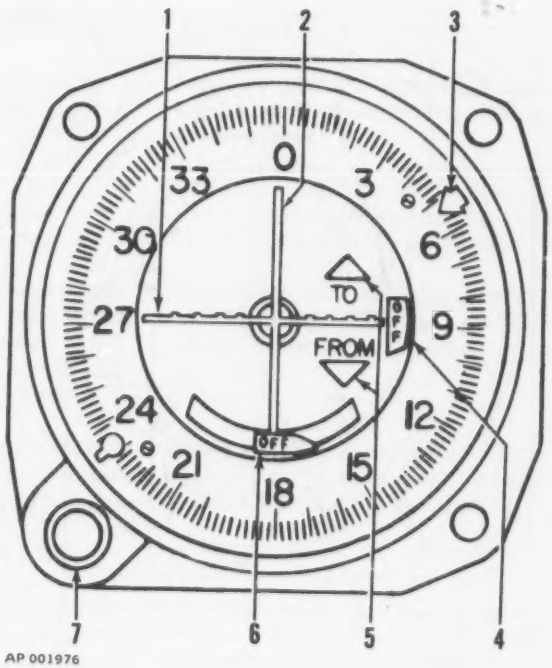
c. One Radio Receiving Set AN/ARN-30E, one Direction Finder Set AN/ARN-59, and one TACAN Navigation Set AN/ARN-52.

3-18. Course Indicator - Selectors.

The course indicator-selectors provide heading and glideslope deviation information, for the TACAN, VOR, and glideslope facilities and course selection control for the TACAN. The course indicator-selectors are protected by the 2-ampere GYRO COMPASS circuit breaker on the right subpanel. Figures 3-11 and 3-12 illustrate the course indicator-selectors.

a. Course Indicator-Selector (ID-453/ARN) Functions:

CONTROL	FUNCTION
Glideslope indicator	Indicates vertical position of the aircraft relative to the glideslope signal.
Course deviation indicator	Indicates lateral deviation from the selected course.
Course index	Indicates the desired magnetic course to or from the selected station.
OFF flags	OFF flag at six o'clock position indicates usability of the VOR or localizer signal.

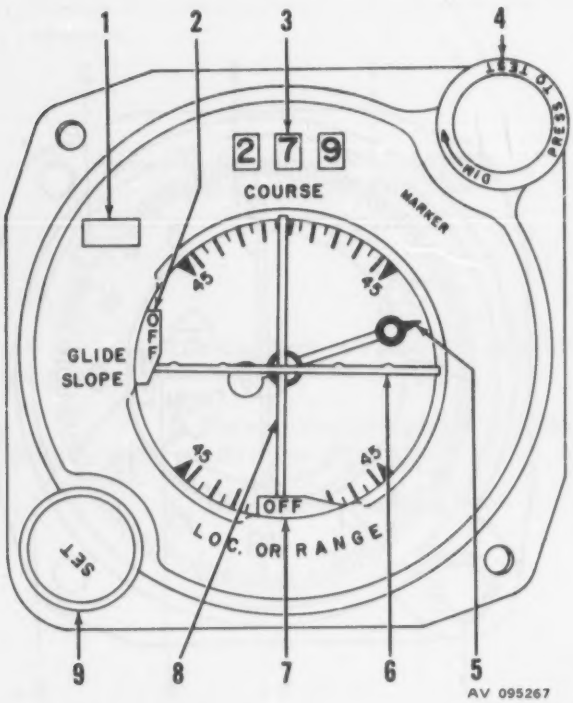


1. Glideslope indicator
2. Course deviation indicator
3. Course index
4. OFF flag
5. TO-FROM indicator
6. OFF flag
7. Course selector knob

Figure 3-11. Course Indicator-Selector (ID-453/ARN)

	OFF flag at three o'clock position indicates power on-off or operating strength of the glideslope signal.
TO-FROM indicator	Indicates whether course selected is toward or away from the received station.
Course selector knob	Provides a means of rotating the course index to the desired magnetic course.

b. Course Indicator-Selector (ID-387/ARN) Functions:



1. TO-FROM indicator
2. GLIDESLOPE OFF flag
3. COURSE indicator
4. MARKER beacon indicator
5. Heading pointer
6. GLIDESLOPE indicator
7. LOC or RANGE OFF flag
8. Course deviation indicator
9. SET control

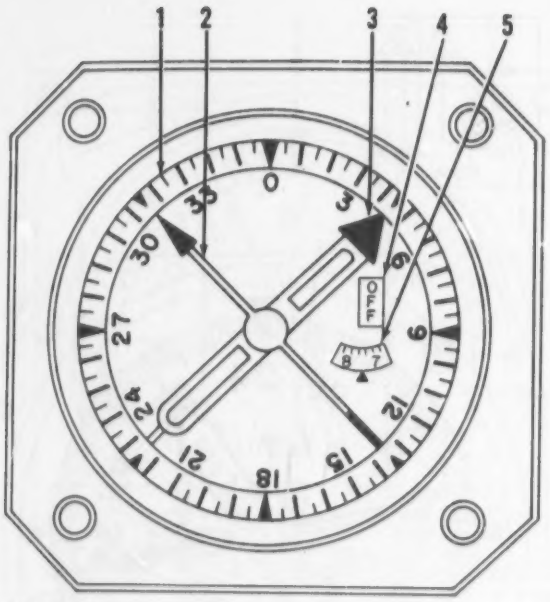
Figure 3-12. Course Indicator-Selector (ID-387/ARN)

CONTROL	FUNCTION
TO-FROM indicator	Indicates whether the course selected is toward, or away from, the selected station.
OFF flags	Indicate navigation signals are unreliable or loss of power in aircraft navigation system.
COURSE indicator	Indicates the desired magnetic course.
MARKER beacon indicator	Illuminates when the aircraft passes over a marker beacon station.
Heading pointer	Indicates difference between actual aircraft magnetic heading and the manually established course.
GLIDESLOPE indicator	Indicates vertical position of the aircraft relative to the glideslope signal.
Course deviation indicator	Indicates lateral course deviation during VOR or localizer operations.
SET control	Controls course indicator to establish the required magnetic course.

3-19. Bearing Distance Heading Indicator. (ID-663C/U). U-8G

The bearing distance heading indicator (figure 3-13) is a combination type indicator consisting of a compass card, single needle pointer, double needle pointer, an OFF flag, and a distance indicator. An ADF/VOR switch and an ADF/TACAN switch are located on the instrument panel (figure 2-25). The control/indicators and their functions are as follows:

CONTROL	FUNCTION
Compass card	Indicates aircraft magnetic heading.
Single needle pointer	Indicates ADF or VOR bearing depending on position of ADF/VOR switch.
Double needle pointer	Indicates ADF or TACAN bearing depending on position of ADF/TACAN switch.



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1. Compass card
2. Single need pointer
3. Double needle pointer
4. OFF flag
5. Distance indicator

Figure 3-13. Bearing Distance Heading Indicator (ID-663C/U)

OFF flag	Indicates OFF when course is FROM station or when distance indicator is searching.
Distance indicator	Indicates distance to TACAN station or another aircraft in nautical miles.
ADF/VOR switch	Controls single needle pointer and allows selection of ADF or VOR information.
ADF/TACAN switch	Controls double needle pointer and allows selection of ADF or TACAN information.

3-20. Bearing Distance Heading Indicator (ID-663C/U). U - 8D ASAC

The bearing distance heading indicator (figure 3-13) is a combination-type indicator consisting of a compass card, single needle pointer, double needle pointer, an OFF flag and a distance indicator. Two toggle switches are located on the instrument panel (figure 2-24) and are marked for the different navigational configurations as follows:

Configuration No. 1: ADF 1, VOR 2 switch and ADF 1, ADF 2 switch.

Configuration No. 2: ADF 1, VOR 2 switch and ADF 1, VOR 1 switch.

Configuration No. 3: ADF, VOR switch and ADF, TACAN switch.

The control/indicators and their functions are as follows:

CONTROL	FUNCTION
Compass card	Provides aircraft magnetic heading at top of instrument from gyro compass.
Single needle pointer	Provides ADF or VOR bearing information depending on ID-250/663 selector position.
Double needle pointer (configuration No. 1 - two ADF and one OMNI)	Provides ADF 1 or ADF 2 information depending on ID-250/663 selector switch position.
Double needle pointer (configuration No. 2 - two OMNI and one ADF)	Provides ADF 1 or VOR 1 information depending on ID-250/663 selector switch position.
Double needle pointer (configuration No. 3 - one TACAN, one OMNI and one ADF)	Provides ADF or TACAN information depending on ID-250/663 selector switch position.
OFF flag	Indicates OFF when range or azimuth information is not available when TACAN system locks onto the selected heading. (applicable to configuration No. 3 only).
Distance indicator	Indicates distance to TACAN station or another aircraft in nautical miles. (applicable to configuration No. 3 only).

ADF/VOR switch	Allows selection of automatic direction finding information or OMNI radio information.
ADF 1/ADF 2 switch (configuration No. 1 two ADF and one OMNI)	Controls double needle pointer and allows selection of ADF 1 or ADF 2 information depending on selector switch position.
ADF 1/VOR 1 switch (configuration No. 2 two OMNI and one ADF)	Controls double needle pointer and allows selection of ADF 1 or VOR 1 information depending on selector switch position.
ADF/TACAN switch (configuration No. 3 one TACAN, one OMNI and one ADF)	Controls double needle pointer and allows selection of ADF or TACAN information depending on selector switch position.

3-21. Radio Magnetic Indicator (ID-250/ARN).

RU-8D

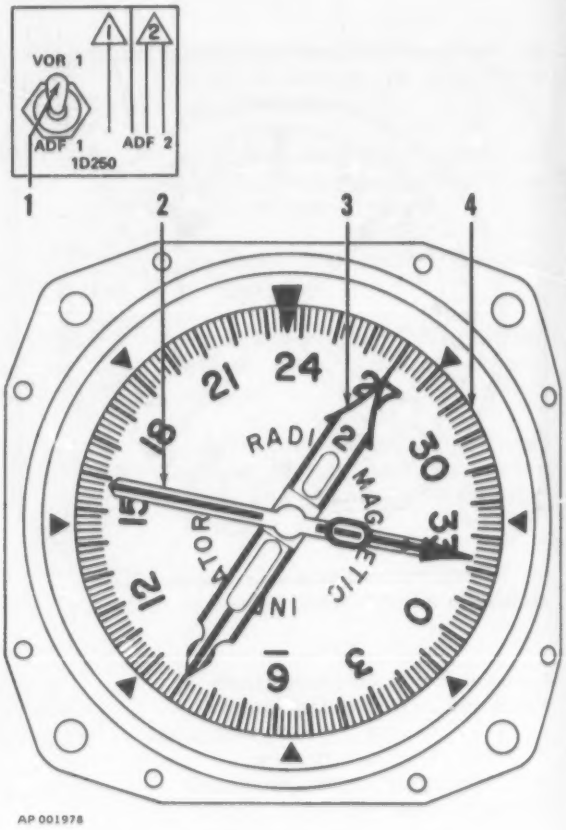
The radio magnetic indicator (figure 3-14) is a navigational aid which provides aircraft magnetic heading and ADF and VOR information to the pilot. The control/indicators and their functions are as follows:

CONTROL	FUNCTION
ADF/VOR switch (on instrument panel)	Selects and applies ADF or VOR signal to single-needle pointer.
Single needle pointer	Displays information from the No. 1 VOR or ADF depending on position of ADF/VOR switch.
Double needle pointer	Displays information from the No. 2 VOR or ADF, depending on which facility is installed.
Compass card	Indicates aircraft magnetic heading at top of dial.

3-22. Radio Magnetic Indicator (ID-998/ASN).

U-8G

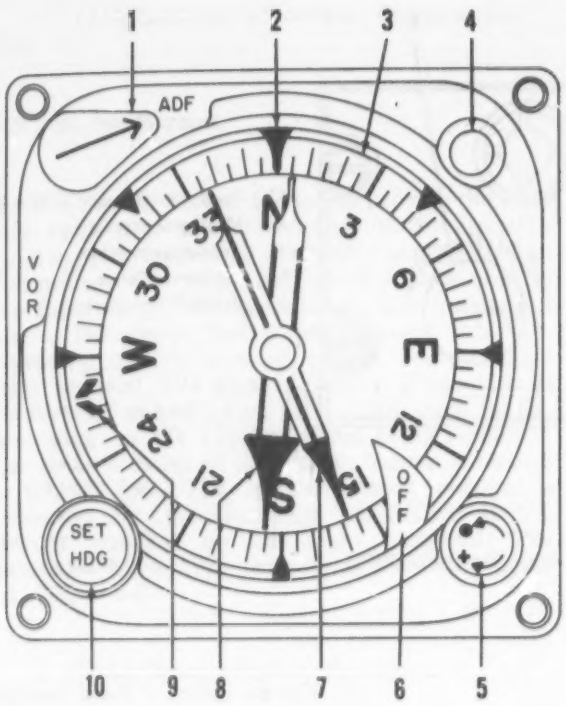
The radio magnetic indicator (figure 3-15) is a navigational aid which provides aircraft magnetic heading and ADF, VOR, and TACAN information to the pilot. The control/indicators and their functions are as follows:



1. ADF/VOR switch
2. Single needle pointer
3. Double needle pointer
4. Compass card

Figure 3-14. Radio Magnetic Indicator (ID-250/ARN)

CONTROL	FUNCTION
ADF/VOR switch	Selects and applies ADF or VOR signal to single-needle pointer.
Compass card	Indicates aircraft magnetic compass heading at top of dial.
Annunciator window	Indicates gyro magnetic compass synchronization in slaved mode.
Synchronizing control	Synchronizes compass.
OFF flag	Indicates equipment failure.



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1. ADF/VOR switch
2. Heading index
3. Compass card
4. Annunciator window
5. Synchronizing control
6. OFF flag
7. Single-needle pointer
8. Double-needle pointer
9. Heading cursor
10. SET HDG control

Figure 3-15. Radio Magnetic Indicator (ID-998/ASN)

Single-needle pointer	Indicates ADF bearing or VOR magnetic bearing, depending on position of ADF/VOR switch.
Double-needle pointer	Displays ADF or TACAN information, depending on position of ADF/TACAN switch.
Heading cursor	Provides visual indication of desired heading.
SET HDG control	Sets heading cursor.
ADF/TACAN switch (located on instrument panel)	Selects and applies ADF or TACAN information to double-needle pointer.

3-23. VOR Receiver (AN/ARN-30E).

This unit is an airborne navigation communication radio whose function is to receive and interpret VHF omni directional radio range (VOR) and localizer (LOC) signals in the frequency range of 108.00 to 126.90 MHz. Visual indications of the VOR and localizer signals are displayed on the RMIs and the course indicator-selectors. Signal reception is limited to line of sight and by the power of the transmitter with a maximum range of 120 miles. Audio signals are fed to the audio control panels. Figure 3-16 illustrates the control panel for the VOR ILS receiver. The associated antennas are shown in figure 2-1, 2-2, or 2-3.

a. VOR Control Panel Switch Functions (figure 3-16).

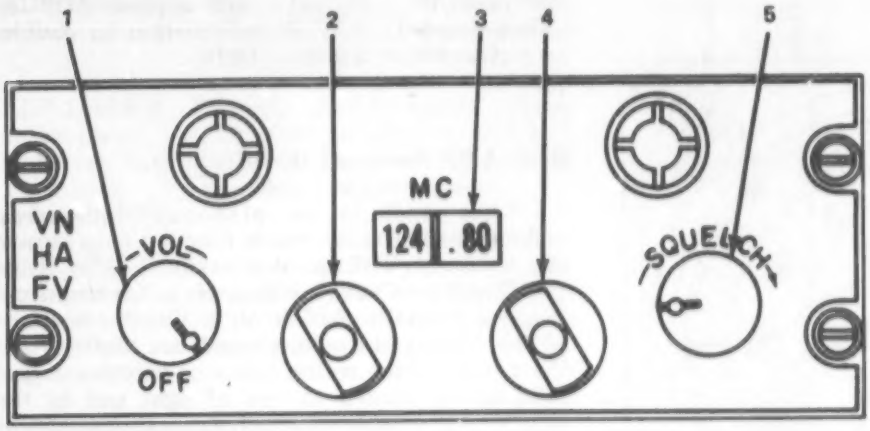
CONTROL	FUNCTION
Power switch and VOL control	
OFF (counter-clockwise)	Turns set off.
VOL	When rotated clockwise, increases volume.
Megahertz selector	Selects required frequency in one MHz steps as indicated by first three digits of frequency indicator.
Frequency indicator	Indicates the operating frequency.
Kilohertz selector	Selects required frequency as indicated by last two digits of frequency indicator.
SQUELCH control	Adjusts squelch.

b. VOR Receiver Operation.

NOTE

The following procedures apply to both VOR receivers if two are installed.

(1) Turn-on procedure: Power switch — On.



1. Power switch and VOL control
2. Megahertz selector
3. Frequency indicator
4. Kilohertz selector
5. SQUELCH control

AP 001979

Figure 3-16. VOR Control Panel (AN/ARN-30E)

(2) VOR receiver operating procedure:

1. Frequency selectors — Select.

2. VOL control — As required.

3. ADF/VOR switch (instrument panel, U-8G) — VOR.

4. ADF/VOR switch (ID-998/ASN) — VOR.

5. Course selector knob (ID-387/ARN) — Set to required course.

6. Course deviation indicator — Read lateral deviation from selected course.

7. To determine course to station on course indicator-selector:

(1) Set control — Rotate knob until course deviation pointer is centered and TO-FROM flag reads TO.

(2) Course index — Read course to station.

8. To determine bearing from station on course indicator-selector:

(1) Set control — Rotate knob until course deviation pointer is centered and TO-FROM flag reads FROM.

(2) Course index — Read bearing from station.

9. To determine course to station on RMI or heading indicator ID-998, ID-663:

(1) ADF/VOR switch (instrument panel or RMI) — VOR.

(2) Single needle on indicators — Read course to station.

(3) Localizer (LOC) receiver operating procedure:

1. Frequency selectors — Select.

2. ADF/VOR switches (instrument panel, figure 2-24, 2-25, or 2-26) — VOR.

3. Course deviation indicator (course indicator-selector) — Steer as required to center needle.

(3) VHF communications operating procedure:

1. Frequency selectors — Select.

2. VOL control — As required.

(4) Shutdown procedure: Power switch — OFF.

3-24. Marker Beacon.

The marker beacon is used to provide the pilot with visual and aural indication of the aircraft's position with respect to a 75 MHz marker beacon transmitter. The visual indication is presented in the form of a flashing light on the instrument panel. The light flashes at different intervals, depending on the type of marker beacon signal being received. The aural indication is provided in the form of an audio tone (400, 1300, or 3000 Hz, depending on the type of signal being received). The distance range of the marker beacon is vertical to 50,000 feet. The marker beacon receiver is protected by the 3-ampere MARKER RCVR circuit breaker on the right subpanel. The associated blade type antenna is shown in figure 2-1, 2-2, or 2-3.

a. Marker Beacon Switch Functions.

CONTROL	FUNCTION
MARKER BEACON indicator	Illuminates when the aircraft passes over a marker beacon station.
AUDIO control	Turns marker beacon receiver on and controls volume of received audio.
HIGH-LOW switch	Controls sensitivity of marker beacon receiver.

b. Marker Beacon Operation.

(1) Turn on procedure: Marker beacon AUDIO control — on.

(2) Operating procedure:

1. MB switch (audio control panel) — ON. (RECEIVERS-NAV switch on U-8D ASAC).

2. AUDIO VOL-OFF control — On, adjust volume as desired.

3. HIGH-LOW switch — As required.

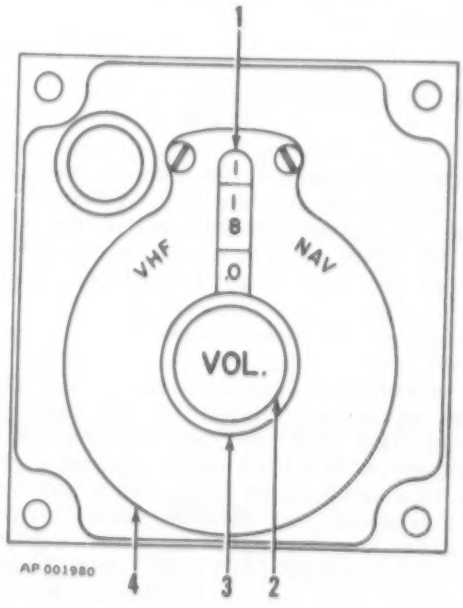
(3) Shutdown procedure: AUDIO control — off.

3-25. Glideslope Receiver (AN/ARA-54).

The glideslope receiver provides vertical guidance information to the glideslope deviation indicator on the course indicator-selectors (figures 3-11 and 3-12) during Instrument Landing System (ILS) approaches. The VHF NAV control panel (figure 3-17) is used to control application of power and frequency selection of the glideslope circuits within the receiver. The glideslope receiver operates on any one of the 20 available channels within the frequency range of 329.3 to 335.0 megahertz. The range is limited to line of sight. The glideslope receiver is protected by the 3-ampere GLIDESLOPE circuit breaker located on the right subpanel. The associated antennas are shown in figure 2-1, 2-2, or 2-3.

a. Glideslope Switch Functions (figure 3-17).

CONTROL	FUNCTION
Frequency indicator	Indicates selected frequency.



1. Frequency indicator
2. VOL control
3. Kilohertz selector
4. Megahertz selector

Figure 3-17. Glideslope Control Panel (AN/ARA-54)

VOL control	Turns set on and controls volume of received audio.
Kilohertz selector	Selects desired frequency in 100 kHz steps.
Megahertz selector	Selects desired frequency in 1 MHz steps.

b. Glideslope receiver operation.

(1) Turn-on procedure: VOL control — on.

(2) Glideslope receiver operating procedure:

1. Frequency selectors — Select localizer frequency.

2. VOR ILS receiver — In operation.

3. Glideslope indicator (course indicator-selectors) — Read glideslope indications.

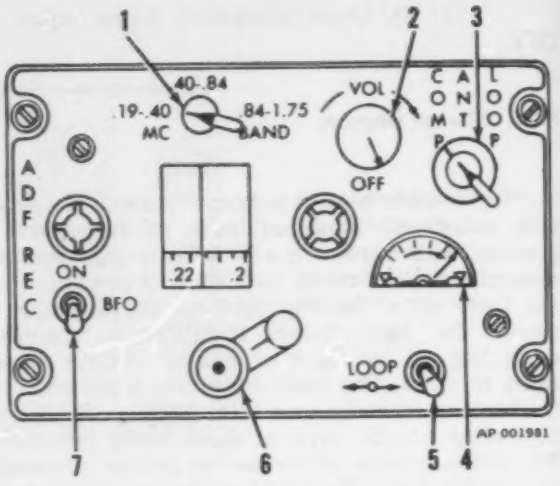
(3) Shutdown procedure: VOL control — Off.

3-26. ADF Radio Set (AN/ARN-59).

The ADF radio set is an airborne low-frequency radio direction finder which receives signals from transmitters in the 190 to 1750 kHz range, to provide a visual and aural indication of the aircraft's bearing in relation to the transmitter. The set can also be used for homing and position fixing. Reception distance of reliable signals depends on the power output of the transmitting station and the atmospheric conditions. Bearing indications are displayed visually on the RMIs and aural signals are applied to the audio control panels. The ADF radio set is protected by the 5-ampere ADF RCVR circuit breaker located on the right subpanel. On aircraft equipped with dual ADF receivers, two 5-ampere circuit breakers are located on the right subpanel. Figure 3-18 illustrates the ADF (ADF REC) control panel. The associated loop and sense antennas are shown in figure 2-1, 2-2, or 2-3.

a. ADF Control Panel Switch Functions (figure 3-18).

CONTROL	FUNCTION
MC-BAND switch	Selects frequency band in which receiver will operate.



1. MC-BAND switch
2. Power switch
3. Function switch
4. Tuning meter
5. LOOP switch
6. Tuning crank
7. BFO-ON switch

Figure 3-18. ADF Control Panel (AN/ARN-59)

Power switch	
OFF	Turns set off.
VOL	Turns set on and adjusts volume.
Function switch	Determines operating mode:
COMP	Allows homing or automatic direction finding operation.
ANT	Provides reception using sense antenna only.
LOOP	Allows aural-null homing and manual direction finding operation.
Tuning meter	Indicates relative strength of received signal.
LOOP switch	Provides a means of rotating the loop antenna left or right through 360 degrees.

Tuning crank	Tunes receiver.
BFO-ON switch	Turns the BFO on or off.

b. ADF Radio Set Operation.

NOTE

The following procedures apply to both ADF receivers if two are installed.

(1) Turn on procedure: Power switch — On, adjust volume.

(2) To operate set as automatic direction finder:

1. Function switch — COMP.
2. MC Band switch — As required.
3. NAV switch (audio control panel) — ON.
4. ADF/VOR switch (instrument panel or RMI) — ADF.
5. ADF/TACAN switch (if installed) — ADF.
6. Tuning crank — Required frequency (tune for maximum deflection on tuning meter).

NOTE

If signal strength is too weak for easy identification when the function switch is at the COMP position, temporarily switch to ANT position to increase signal strength and permit a more accurate station identification.

7. Single needle on RMI (also double needle on heading indicator, U-8G or U-8D ASAC) — Read course to station.

(3) To operate set for sense antenna direction finding:

1. Function switch — ANT.
2. MC Band switch — As required.
3. BFO-ON switch — As required.
4. Power switch — Adjust volume.
5. Tuning crank — Required frequency (tune for max on tuning meter).

(4) To operate set for aural-null direction finding:

1. Function Switch — ANT.
2. BFO-ON switch — ON.
3. MC Band switch — As required.
4. Power switch — Adjust for minimum audio output.
5. ADF/VOR switch (instrument panel or RMI) — ADF.
6. BFO-ON switch — Off.
7. Function switch — LOOP.
8. LOOP switch — L or R. Rotate antenna left or right until a null is reached (minimum sound in headsets).
9. Single needle on RMIs (pilot's ID-998, copilot's ID-250) — Read course to station.

NOTE

The true null and direction to the radio station may be indicated by either end of the single needle. This ambiguity must be solved to determine proper direction to the station.

(5) Shutdown procedure: Power switch OFF.

3-27. Tacan Radio Set (AN/ARN-52) ( ).

NOTE

Complete provisions for the AN/ARN-52 TACAN are provided in U-8D, U-8D ASAC, and U-8G aircraft. When the AN/ARN-52 TACAN is installed an ID-387/ARN course indicator selector and an ID-663/U bearing, distance heading indicator are installed and the ID-250/ARN radio magnetic indicator is removed.

The TACAN radio set is an airborne navigational set that operates in conjunction with

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selected TACAN ground stations or other TACAN equipped aircraft to provide bearing and distance to selected destination. Visual indications of bearing to destination are displayed on the course indicator-selector (figures 3-11 and 3-12). Distance to destination information is displayed on the bearing distance heading indicator (figure 3-13). Application of power, channel and mode selection is provided by the TACAN control panel (figure 3-19). The TACAN set operates on any one of 126 preset channels and has a distance range of approximately 300 miles. An audio tone is applied through the audio control panel to indicate TACAN signal reception. The TACAN radio set is protected by the 5-ampere ARN-52 AC and ARN-52 DC circuit breakers on the instrument panel. The associated antenna is shown in figure 2-1 or 2-3.

a. Tacan Control Panel Switch Functions (figure 3-19).

CONTROL	FUNCTION
CHAN indicator	Indicates the operating channel.
CHAN selector	Provides selection of one of 126 preset TACAN channels for receiving and transmitting.
Mode selector	Determines operating mode:
OFF	Turns set off.
REC	Selects receive portion of receiver-transmitter for course information.
T/R	Selects transmit and receive function of receiver-transmitter for course and distance information.
A/A	Selects air-to-air transmit and receive function for range information to a cooperating aircraft.
VOL control	Adjusts volume.

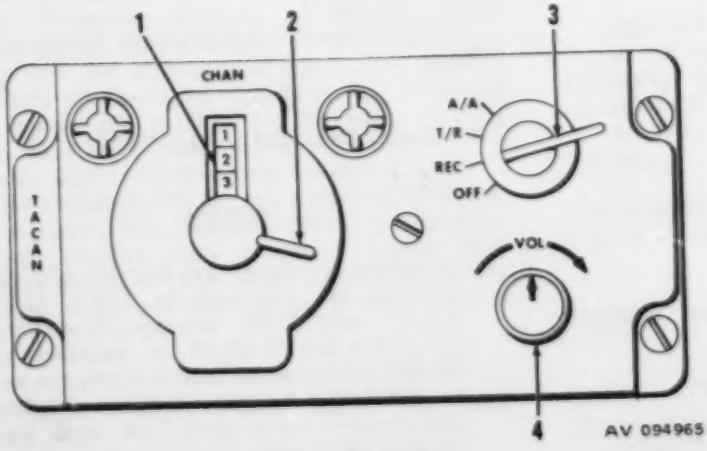
b. Tacan Navigation Set Operation.

(1) Turn-on procedure:

1. Mode selector — REC.
2. VOL control — As required.

(2) To determine course only to a selected ground station:

1. CHAN selector — As required.
2. Mode selector — REC.
3. TACAN/ADF switch (instrument panel, figure 2-24 or 2-25) — TACAN, if required.



1. CHAN indicator
2. CHAN selector
3. Mode selector
4. VOL control

Figure 3-19. TACAN Control Panel (AN/ARN-52)

4. Double needle on RMI and heading indicator (ID-998, ID-663) (figure 3-15 and 3-13) — Read course.

(3) To determine course and range to a selected ground station:

1. CHAN selector — As required.

2. Mode selector — T/R.

3. TACAN/ADF switch (instrument panel) — TACAN.

4. Double needle on RMI and heading indicator (ID-998, ID-663) — Read course.

5. MILES indicator (heading distance indicator ID-663; figure 3-13) — Read range.

(4) To determine course:

1. TACAN controls — Set-up ((1) or (2) above).

2. SET control (course indicator-selector ID-387 figure 3-12) — As required.

3. Course deviation indicator (ID-387) — Steer towards needle.

4. Heading pointer (course indicator-selector ID-387) — Read deviation from selected course. This pointer will show the drift angle, if any, when the course deviation indicator is centered.

(5) To determine course to the TACAN station:

1. SET control (course indicator-selector ID-387) — Rotate until course deviation indicator is centered and TO-FROM flag reads TO.

2. Course indicator (course indicator-selector ID-387) — Read course to station.

(6) To determine bearing from TACAN station:

1. SET control (course indicator-selector ID-387) — Rotate until course deviation indicator is centered and TO-FROM flag reads FROM.

2. Course indicator (course indicator-selector ID-387) — Read bearing from station.

(7) To operate for air-to-air range tracking:

1. Mode selector — A/A.

2. CHAN selector — Set 63 channels difference from master aircraft channel selector.

3. Distance indicator (ID-663) — Read range to aircraft being tracked.

(8) Shutdown procedure: Mode selector — OFF.

3-28. Doppler Navigation Set (AN/ASN-64). RU-8D

The doppler navigation set measures groundspeed and drift angle (figure 3-20 and 3-21). The navigation set produces continuous outputs representing groundspeed from -50 to +350 knots, and drift angles up to 90 degrees left and right. These outputs are induced into the AN/AYA-3 Computer Group Doppler for the computation of present position as well as bearing and distance to destination. The doppler navigation system is protected by a 5-ampere ASN-64 DOPPLER circuit breaker located on the overhead power distribution panel. Refer to TM 11-5841-256-12 for complete operational procedures. The associated antenna is shown in figure 2-2.

NOTE

Perform procedure with engine warming up at 1500 RPM and 750 VA inverter operating.

a. Normal Operation.

NOTE

C-12 Compass is in mag mode.

1. C-12 selected to proper altitude, aligned on mag compass heading and annunciator needle erect.

2. Turn doppler to stand-by.

3. Check variation is set for location.

NOTE

Allow minimum of two minutes for doppler warm up.

4. Check winds on VSI and set to 0 (zero) or to known wind, from tower.

5. Turn doppler to land position.

6. Lock on should occur within 20 to 30 seconds.

(1) Memory flag should go down and yellow light should go out.

(2) Ground speed jumping (checking) ±5 knots.

7. If lock on occurs, return doppler to standby.

8. Set in coordinates as necessary in present position, destination one and destination two.

NOTE

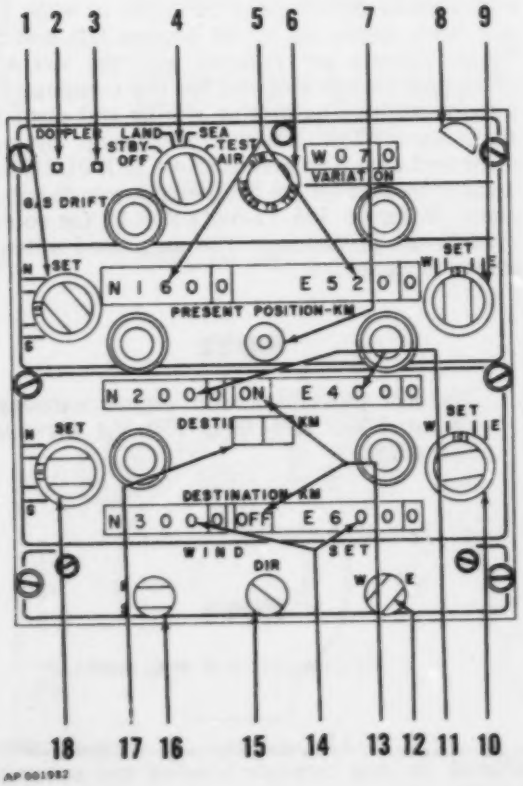
Insure slew knobs for PPI and winds are in neutral position.

9. Remain in standby until on takeoff roll.

NOTE

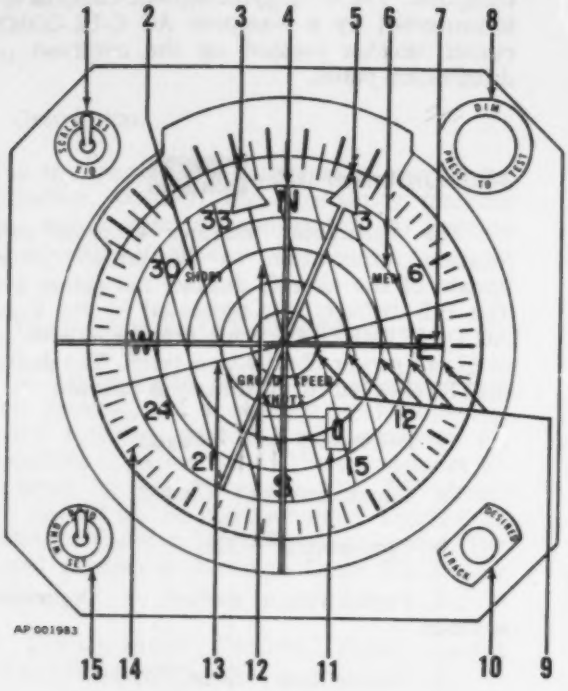
If check performed in chocks turn doppler off prior to taxi and back to standby after engine run up is completed.

10. Turn doppler to LAND on takeoff roll. Update doppler at the end of runway or over beacon as soon after takeoff as possible and again after leveling off at altitude.



1. North/South slow or fast slew switch
2. Manual ground speed high or low slew switch
3. Manual antenna left/right slew switch
4. Doppler system ON-OFF and function selector switch
5. Present position indicator
6. Memory operation press to test light
7. Present position calculations press to store button
8. East/West magnetic variation knob
9. East/West slow or fast slew switch
10. OFF East/West destination counter slew switch
11. Destination 1 position indicator
12. East/West wind velocity component set switch
13. Destination flags - indicates active or inactive counter
14. Destination 2 position indicator
15. TMG pointer knob
16. North/South wind velocity component set switch
17. Destination select switch
18. OFF North/South destination counter slew switch

Figure 3-20. Doppler Control-Indicator (AN/ASN-64)



1. Scale switch
2. Range scale flag
3. Desired track grid
4. East-west component vertical bar
5. TMG rotary power (track-made-good)
6. Operation (land or sea) mode memory flag
7. North-south component horizontal bar
8. Memory warning lamp
9. Range scale marker rings (0-5, 0-50, 0-500 nautical miles)
10. Desired track grid knob
11. Ground speed indicator
12. Present position marker
13. Crossbar intersection (destination distance/bearing)
14. Stationary compass card
15. Wind velocity read set switch

Figure 3-21. Doppler Velocity Steering Indicator (AN/ASN-64)

NOTE

After takeoff with no lock on, switch doppler to stand-by momentarily, then back to land. Lock on should occur within two minutes. If not, toggle GS to approximate airspeed. Doppler should be updated at working altitude prior to starting the mission whenever possible. The doppler takes approximately 30 seconds to become accurate going to land position. Once the doppler is turned on the pilot will maintain sufficient engine RPM to keep one generator cut in at all times, approximately 1500 RPM. This will preclude power surges to the 750 VA inverter and doppler. Never turn off the 750 VA inverter prior to turning off the doppler. This applies when switching from main to stand-by inverter.

b. Alternate Procedures (to be used if lock on does not occur).

1. Engine — 1500 RPM.

2. Doppler — STBY.

3. PPI (readout) — 0 (zero) cut N/S and E/W coordinates.

4. Ground Speed — Toggle ground speed up to 250 kts, release toggle switch and ground speed return: 0 ± 7 kts (493-007).

5. Drift Switch — Slew tracking needle 30°, not necessarily in both directions.

6. Wind set — Slew winds off VSI, return slew knobs to neutral.

7. Doppler — Switch to land mode. Winds should return to 0 + 8 kts, memory flag down yellow light on.

8. Wind set — Return switch to neutral. Ground speed indicator should jump (checking).

9. C-12 Compass — Select DF mode. Carefully position track made good needle to any 45° position on VSI.

10. Doppler — Switch to test position. Digital read out of N/S and E/W counters on the PPI should be counting approximately the same.

NOTE

The track made good needle must be on 45° for both to readout approximately the same.

11. Press to Store — Push-press to store button. Remain in press to store position for approximately 30 seconds then push press to store button to restore PPI counters. PPI readout should catch up and read about the same.

12. Doppler — Check complete. Return C-12 to mag mode - align C-12 to mag compass. Note VG ANNUNCIATOR needle erect.

13. Doppler — Switch to land position and attempt lock on. With no lock on, return to line for maintenance and advise technician of abnormal indications.

NOTE

Experience has shown that dopplers do work when all indications show otherwise. Personal experience dictates whether to continue with flight or return immediately to line for replacement aircraft. Treat the doppler like the expensive piece of equipment it is: gently.

3-29. Gyro Magnetic Compass System (C-12). RU 8D

The Gyromagnetic compass system provides accurate heading reference information to the aircraft pilot and to the aircraft doppler navigation computer. The C-12 gyromagnetic compass system is protected by a 5-ampere AC C-12 COMPASS circuit breaker located on the overhead power distribution panel.

3-30. Driftmeter (B-3). RU 8D

The Driftmeter provides accurate position location information to the mission crew for update of the aircraft doppler navigation system. The B-3 driftmeter is protected by the 2-ampere AC DRIFTMETER circuit breaker located on the overhead power distribution panel. The driftmeter may be checked for operation as follows:

1. Driftmeter gyro — Caged.

2. Circuit breaker — Closed.

3. Gyro switch — ON.

4. Pushbutton switch — Depressed 60 seconds.

5. Reticle lines — Shart Focus.

6. Driftmeter — Turns freely (set to 0 degrees).

7. Nose wheel — should be visible looking forward.

8. Gyro — Uncage.

9. Steadiness of image — Check.

10. Gyro — Cage.

11. Driftmeter to 180° azimuth — Set and locked.

12. Gyro switch — OFF until airborne.

Section IV. TRANSPONDER AND RADAR

3-31. Description.

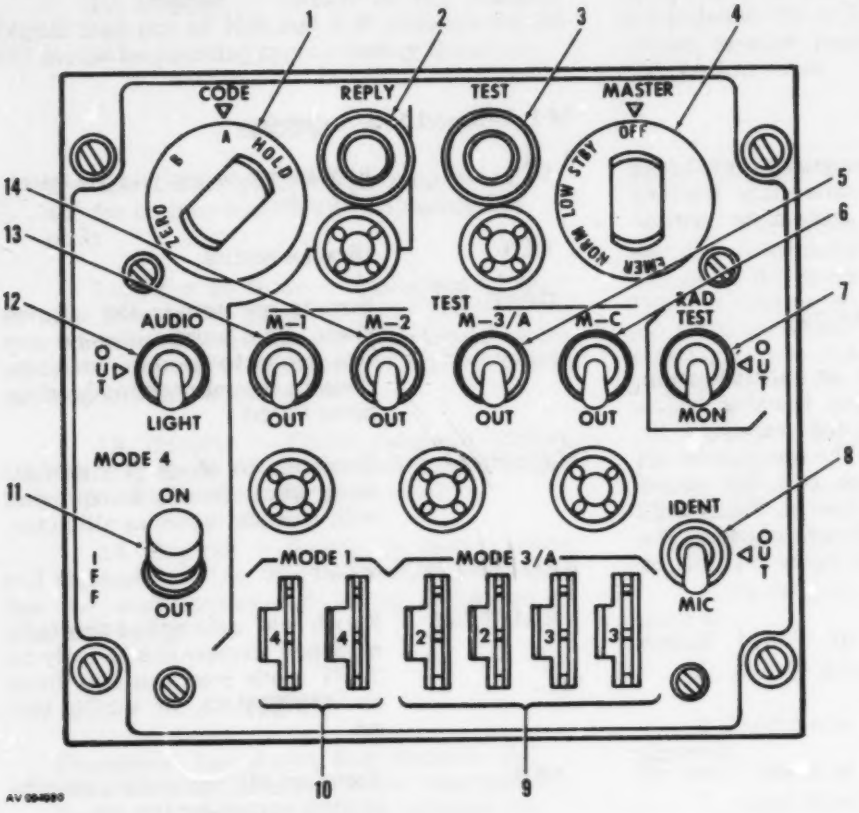
The transponder and radar group provides an identification, position and emergency tracking system, and a radar beacon system to provide accurate position location.

3-32. Transponder Set (AN/APX-72).

The transponder set is an identification, position tracking, and emergency tracking device. This set receives, decodes, and responds to, interrogations by search radar. The transponder set is protected by the 10-ampere IFF RT circuit breaker located on the right subpanel. Figure 3-22 illustrates the transponder (IFF) control panel. The associated antenna is shown in figure 2-1, 2-2, or 2-3.

a. Transponder Control Panel Switch Functions (figure 3-22).

CONTROL	FUNCTION
CODE control	Selects dialed in mode 4 code of the day.
REPLY light	Indicates valid mode 4 interrogations and replies when MODE 4 AUDIO LIGHT switch is in AUDIO or LIGHT positions.
TEST light	Indicates the proper response has been generated when the M-1, M-2, M-3/A, M-C switches are placed in TEST position. Also illuminates when RAD TEST-MON switch is in MON position and replies are made to SIF interrogations.
MASTER control	
OFF	Turns set off.
STBY	Places set in warm-up (standby) condition.
LOW	Places set at low sensitivity.
NORM	Operates set at normal sensitivity.
EMER	Transmits emergency reply.
M-1, M-2, and M-3/A switches	
ON	Permits set to reply in the selected mode.
OUT	Disables replies.
TEST	Permits self test in the selected mode. The transponder set can also reply to ground interrogations in the selected mode while being tested.
M-C switch	Responds to Mode C interrogations when aircraft is equipped with altitude reporting altimeter.
RAD TEST-MON switch	
RAD TEST	Enables an appropriately equipped transponder to reply to TEST mode interrogations from an AN/UPM-92, or similar test set.
MON	Turns on SIF monitoring circuits in the transponder test set.
OUT	Disables both test features.
IDENT-MIC switch	
IDENT	Activates identification feature.
MIC	Inoperative in this installation.
MODE 1 and MODE 3/A code selectors	Selects the desired reply codes for modes 1 and 3/A.
MODE 4 ON-OUT switch	
ON	Permits transponder set to decode a mode 4 interrogation.
OUT	Disables mode 4 decoding.
MODE 4 AUDIO-LIGHT switch	
AUDIO	Permits aural and reply light monitoring of valid mode 4 interrogations and replies.
LIGHT	Permits only REPLY light monitoring.



1. CODE control
2. REPLY light
3. TEST light
4. MASTER control
5. M3/A switch
6. M-C switch
7. RAD TEST-MON switch
8. IDENT-MIC switch
9. MODE 3/A code selectors
10. MODE 1 code selectors
11. MODE 4 ON-OUT switch
12. MODE 4 AUDIO-LIGHT switch
13. M-1 switch
14. M-2 switch

Figure 3-22. Transponder Control Panel (AN/APX-72)

b. Transponder Set Operation. If mode 4 operation is required, perform the following procedures after the landing gear has been retracted.

NOTE

To prevent zeroizing the Mode 4 function of the AN/APX-72 transponder, when the landing gear is down (struts compressed) and either transponder or aircraft power is turned off, place the CODE switch momentarily in HOLD position.

(1) Turn on procedure: MASTER control - STBY.

(2) Modes 1, 2, 3/A, and/or 4 operating procedure:

1. MASTER CONTROL — LOW or NORM. Set for required receiver sensitivity.

2. M-1, M-2, M-3/A, and/or MODE 4 ON-OUT switches — ON. Actuate only those switches corresponding to the required codes. The remaining switches should be left in the OUT position.

3. MODE 1 code selectors — Set (if applicable).

4. MODE 3/A code selectors — Set (if applicable).

5. CODE control — Set (as required).

6. RAD TEST-MON switch — MON.

7. TEST light — Monitor to determine when transponder set is replying to an SIF interrogation.

8. MODE 4 AUDIO LIGHT switch — Set (as required to monitor mode 4 interrogations and replies).

9. AUDIO and/or REPLY light — Listen and/or observe (for mode 4 interrogations and replies).

10. IDENT-MIC switch — Press to IDENT momentarily.

(3) To test transponder set operation in code modes 1, 3, and/or 3/A:

NOTE

The following self-tests will not affect, nor prevent, transponder set replies to external interrogations. Test only those modes that are being used.

1. M-1, M-2, and/or M-3/A switches — Momentarily set switches to test position, one at a time.

2. TEST light — Observe for indication as each code switch is set to TEST position. If TEST light fails to light, recheck applicable control settings. If the light does not illuminate after the control settings have been rechecked, either the transponder or the self-test feature is faulty.

(4) Transponder set identification-position operating procedures. The transponder set can make identification-position replies while operating in code modes 1, 2, and/or 3/A, in response to ground station interrogations. This type of operation is initiated by the operator only when directed via the communications system to identify position, or upon arrival at pre-established identification-position (I/P) check points. The identification-position operating procedures are as follows:

1. Modes 1, 2 and/or 3/A — Operating.

2. IDENT-MIC switch — Press momentarily to IDENT, when directed.

NOTE

Holding circuits within the transponder receiver-transmitter will transmit identification-position signals for approximately 30 seconds. This is normally sufficient time for ground control to identify the aircraft's position. During this 30-second period, it is normal procedure to acknowledge via the aircraft communications set that identification-position signals are being generated.

(5) Shutdown procedure: MASTER control — OFF.

c. Transponder Set Emergency Operation.

NOTE

The MASTER switch on the transponder control panel shall be placed in the EMER position only under emergency conditions.

1. Modes 1, 2, and/or 3/A — Operating.

2. Master switch — EMER.

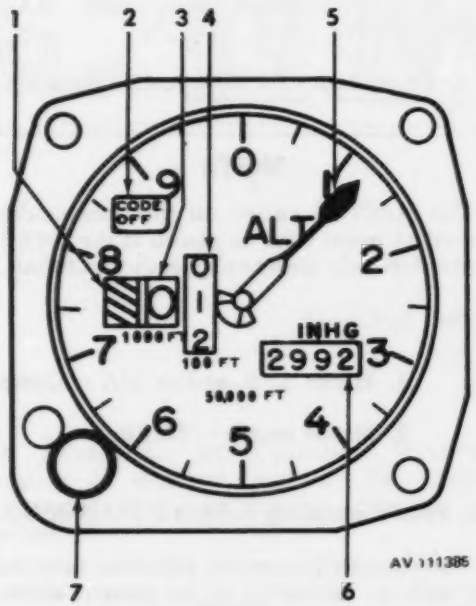
3-33. Pilot's Encoding Altimeter (AAU-32/A).

The encoder/pneumatic altimeter provides the pilot with an indication of his present altitude in addition to providing the transponder altitude information for use in Mode C. This pneumatic counter drum-pointer altimeter is a self contained unit which consists of a precision pressure altimeter combined with an altitude encoder. The display indicates and the encoder transmits, simultaneously, pressure altitude reporting to ground stations. The encoding altimeter is

protected by the 1-ampere ALTM circuit breaker on the right subpanel. Figure 3-23 illustrates the encoding altimeter.

a. Encoding Altimeter Control-Indicator Functions (figure 3-23).

CONTROL	FUNCTION
10,000 foot counter drum	Indicates aircraft altitude in ten thousands of feet.
Diagonal warning symbol	Appears on the 10,000 foot counter when aircraft is below an altitude of 10,000 feet.
CODE OFF flag (red)	Presence in upper left portion of instrument face indicates altitude encoder is inoperative and the system is not operating, or the code flag has failed.
1000 foot counter drum	Indicates aircraft altitude in thousands of feet.
100 foot counter drum	Indicates aircraft altitude in hundreds of feet.
Single needle pointer	Indicates aircraft altitude in hundreds of feet in fifty foot increments.
IN. HG. window	Indicates barometric pressure in inches of mercury as adjusted by the barometric set knob.
Barometric set knob	Permits desired altimeter setting in inches Hg.



1. 10,000 foot counter drum
2. CODE OFF flag
3. 1000 foot counter drum
4. 100 foot counter drum
5. Single needle pointer
6. IN. HG. window
7. Barometric set knob

Figure 3-23. Encoding Altimeter (AAU-32/A)

b. Encoding Altimeter Operation.

(1) Turn on procedure:

1. Battery switch — ON.

2. ALTM circuit breaker — Set.

3. Transponder Mode C Switch (M-C) — ON (for in-flight altitude reporting).

(2) Operating procedure:

1. Barometric set knob. Set desired barometric pressure in IN. HG. window. (A minimum of one minute warm-up time is required prior to setting or checking altimeter operation).

NOTE

If the Baroset knob binds or sticks, abnormal force should not be used to make the setting as this may cause internal gear failure resulting in an altitude error. Settings can sometimes be made by backing off and turning at a slower rate.

2. CODE OFF flag — Check (not visible).

NOTE

If the CODE OFF flag is visible, either DC power is off, the circuit breaker is not set, or there is an internal altimeter encoder failure, since the CODE OFF flag monitors only the encoder function of the altimeter and not transponder condition. The altitude reporting function may be inoperative without the CODE OFF flag showing, in case of transponder failure or

improper control settings. It is also possible to get a good Mode C test on the transponder control with the CODE OFF flag showing. If the CODE OFF flag remains visible, radio contact should be made with a ground radar site to determine if the altitude reporting function is operative.

3. Single needle pointer — Check operation.

NOTE

The altimeter is equipped with a DC powered internal vibrator which is required to overcome friction and assure accuracy. If the vibrator becomes inoperative due to internal failure or DC power failure, the pointer may momentarily hang up when passing from "9" through "0" while climbing, or from "0" through "9" while descending. This hang up will cause lag, the magnitude of which will depend on the vertical speed of the aircraft and the friction in the altimeter. Pilots should be especially watchful for this type failure when the minimum approach altitude lies within the "8" to "1" part of the scale 800-1100, 1800-2100, etc.

NOTE

If the altimeter does not read within 75 feet of field elevation when the correct local barometric setting is used, the altimeter needs re-zeroing or internal failure has occurred. An error of greater than 75 feet also nulifies use of the altimeter for IFR Flight.

c. Encoding Altimeter Emergency Operation. ALTM circuit breaker — Pull (if encoder fault occurs).

3-34. Radar Beacon. RU-8D

The radar beacon receives pulsed interrogations from a radar set and transmits pulsed replies of greater signal strength in the same frequency band. The radar beacon provides accurate position location information to the mission crew for update of the aircraft doppler navigation system. The radar beacon switch box (figure 3-24) provides the controls for the radar beacon. The radar beacon is protected by a 5-ampere circuit breaker located in the switch box assembly. The controls and their functions are as follows:

CONTROL	FUNCTION
PWR switch	
ON	Turns set on.
OFF	Turns set off.
MODE SELECT switch	Determines operating mode.
SINGLE	Selects single pulse mode for transmitted signal.
DOUBLE	Selects double pulse mode for transmitted signal.

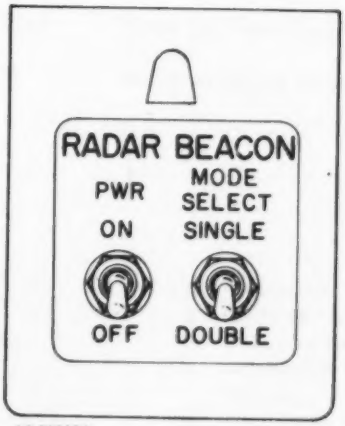


Figure 3-24. Radar Beacon Control

CHAPTER 4

MISSION EQUIPMENT

Section I. MISSION AVIONICS

4-1. Mission System. RU - 8D

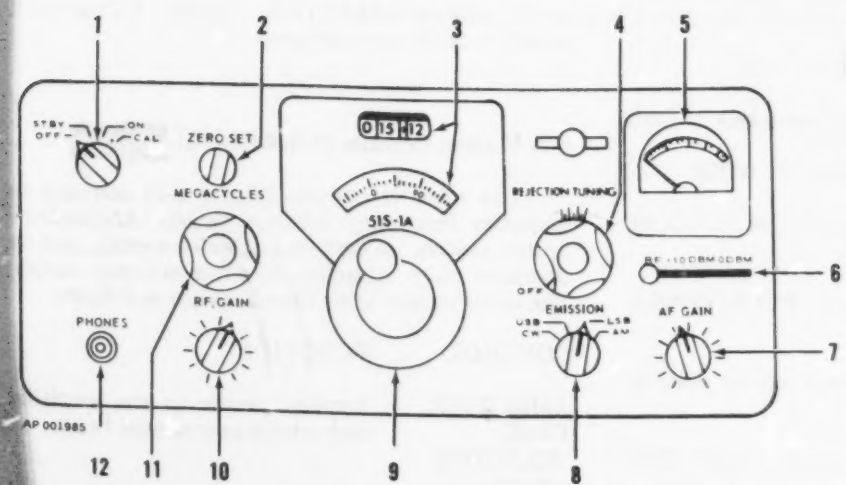
The AN/ARD-15 Mission System operates in the high frequency range and provides surveillance information to the aircraft crew.

4-2. Mission Receivers (51S-1A). RU - 8D

The mission receivers (figure 4-1) are installed in the AN/ARD-15 console. The controls and indicators are located on the front panel of the receiver. The mission receivers are protected by the 15-ampere ARD-15 circuit breaker on the overhead power distribution panel.

a. Mission Receiver Switch Functions (figure 4-1).

CONTROL	FUNCTION
Mode switch	Determines operating mode:
STBY	Power is supplied to all stages of the receiver except the IF amplifier stages.
ON	Receiver is fully operational.
CAL	Used for calibrating the receiver.
ZERO SET control	Adjusts the hairline on the kilocycle dial.
Frequency dials	Indicate the selected band and frequencies within the band.
REJECTION TUNING control	Tunes out interferring heterodyne frequency.
DB meter	Indicates relative RF input or line of gain.
Meter switch	Controls information displayed on DB meter.
RF	Meter indicates relative RF input.
+10 DBM	Meter indicates line of gain.
0 DBM	Meter indicates line of gain.



1. Mode switch
2. ZERO SET control
3. Frequency dials
4. REJECTION TUNING control
5. DB meter
6. Meter switch
7. AF GAIN control
8. EMISSION switch
9. Tuning control
10. RF GAIN control
11. MEGACYCLES tune
12. PHONES jack

Figure 4-1. Mission Receiver (515-1A)

AF GAIN control	Adjusts the volume.
EMISSION switch	Adjusts receiver for type of signal received.
CW	Continuous wave reception is selected.
USB	Upper sideband reception is selected.
LSB	Lower sideband reception is selected.
AM	Provides reception of amplitude modulated signals.
Tuning control	Varies the frequency within the selected band.
RF GAIN control	Varies signal strength in the RF amplifier.
MEGACYCLES tune	Selects the one-megahertz band in which the receiver is to operate.
PHONES jack	Used to plug in a headphone.

b. Mission Receiver Operation.

1. RF preamp circuit breaker — Closed.

2. AMPLIFIER FREQ SELECTOR Switch — WIDE BAND.

3. ARD-15 power switch — ON.

4. Mode switch (both receivers) — ON.

5. Antenna selector switch — WHIP.

6. OPERATOR ONLY/INTERCOM SWITCH — OPERATOR ONLY.

7. Audio control panel — RECEIVERS 3 and 4 — ON.

8. 51S-1 tuning — Check signals audible 2.0 - 3.0 MHz.

9. Antenna selector switch — DF1 TOP RECEIVER.

10. Top receiver — Tuned, AM station 2.1 - 4.1 MHz.

11. AMPLIFIER FREQ SELECTOR switch — 2.1 - 4.1 MHz position. Note that signal level does not decrease.

12. AMPLIFIER FREQ SELECTOR switch — WIDE BAND.

13. Top receiver — Tuned, AM station 4.0 - 7.9 MHz.

14. AMPLIFIER FREQ SELECTOR Switch — 4.0 - 7.9 MHz position. Note that signal level does not decrease.

15. AMPLIFIER FREQ SELECTOR switch — WIDE BAND.

16. OPERATOR ONLY/INTERCOM switch — INTERCOM.

17. Pilot/Copilot mission audio — Check.

18. OPERATOR ONLY/INTERCOM SWITCH — OPERATOR ONLY.

19. Antenna selector switch — DF2 Bottom receiver.

20. Bottom receiver — Checked. Repeat steps 10 thru 18.

21. Pilot mission alert light — Check.

22. 51S-1 Receivers — OFF until airborne.

23. ARD-15 power switch — OFF until airborne.

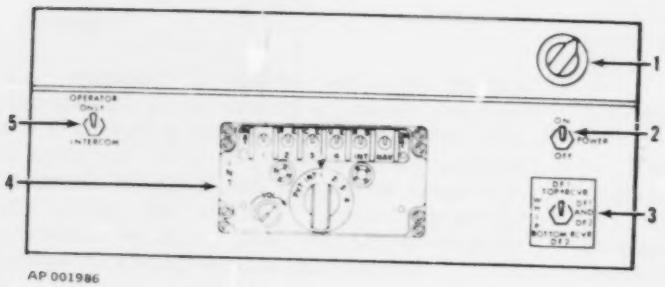
24. AMPLIFIER FREQ SELECTOR switch — OFF until airborne.

4-3. Mission Console (AN/ARD-15). RU · 8D

The mission console (figure 4-2) contains an amplifier frequency selector switch, AN/ARD-15 power switch, an antenna selector switch, and an operator only intercom monitor selector switch. The controls and their functions are as follows:

CONTROL	FUNCTION
AMPLIFIER FREQ SELECTOR switch	Applies power to the amplifier and selects operational band.
POWER switch	Applies power to the mission systems.

Antenna selector switch	Determines antenna to be used:
DF 1 TOP RCVR	Connects the top mission receiver to the dipole antennas and connects bottom receiver to the whip antenna.
WHIP	Connects both the top and bottom receivers to whip antenna.
DF 2 BOTTOM RCVR	Connects the bottom receiver to the dipole antennas and the top receiver to the whip antenna.
OPERATOR ONLY/INTERCOM switch	Selects mission audio:
OPERATOR ONLY	Disables the pilot's and copilot's mission audio.
INTERCOM	Applies mission audio to the pilot's and copilot's interphone control RECEIVERS 4 switch.



1. AMPLIFIER FREQ SELECTOR switch
2. POWER switch
3. Antenna selector switch
4. Audio control panel
5. OPERATOR ONLY/INTERCOM switch

Figure 4-2. Mission Console (AN/ARD-15)

Section II. ARMAMENT

This aircraft is not equipped with armament.

CHAPTER 5
OPERATING LIMITS AND RESTRICTIONS

Section I. GENERAL

5-1. Purpose.

This chapter includes all important operating limits and restrictions that shall be observed during ground and flight operations.

5-2. General.

The operating limitations set forth in this chapter are the direct results of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum utility from the aircraft. Limits concerning maneuvers, weight, and center-of-gravity limitations are also covered in this chapter.

5-3. Exceeding Operational Limits.

Anytime an operational limit is exceeded an appropriate entry shall be made on DA Form 2408-13. Entry shall state what limit or limits were exceeded, range, time above limits, and any additional data that would aid maintenance personnel in the inspection that may be required.

5-4. Minimum Crew Requirements.

The minimum crew required for aircraft operation is one pilot. Additional crewmembers as required will be added at the discretion of the commander, in accordance with pertinent Department of the Army regulations.

Section II. SYSTEM LIMITS

5-5. Instrument Markings.

Instruments which display operating limitations are illustrated in figure 5-1. The operating limitations are color coded on the instrument faces. Color coding of each instrument is explained in the illustration. The instrument illustration also denotes, in bold type, the fuel grade upon which limits are based.

5-6. Instrument Marking Color Codes.

Operating limitations and ranges are illustrated by the colored markings which appear on the dial faces of engine, flight and utility system instruments. RED markings on the dial faces of these instruments indicate the limit above or below which continued operation is likely to cause damage or shorten life. The GREEN markings on instruments indicate the safe or normal range of operation. The YELLOW markings on instruments indicate the range when special attention should be given to the operation covered by the instrument. Operation is permissible in the yellow range, but should be avoided.

5-7. Instrument Glass Alignment Marks.

Limitation markings shall consist of strips of semi-transparent color tape which adhere to the glass outside of an indicator dial. Each tape strip shall align to increment marks on the dial face so correct operating limits are portrayed. The pilot should occasionally verify alignment of the glass to the dial face. For this purpose, all engine instruments (except fuel flow meters) have short, vertical white alignment marks extending from the bottom part of the dial glass onto the fixed base of the indicator. These slippage marks appear as a single vertical line when limitation markings on the glass properly align with reading increments on the dial face. However, the slippage marks appear as separate radial lines when a dial glass has rotated.

5-8. Propeller Limitations.

The propeller limitations for the aircraft are confined to propeller overspeed, which is defined as not exceeding 3750 RPM at any time. This 3750

FUEL GRADE 100/130

TACHOMETER (DUAL)

2400 TO 3200 RPM
NORMAL OPERATING RANGE

3200 TO 3400 RPM CAUTIONARY
(AVOID CONTINUOUS OPERATION)

3400 RPM MAXIMUM ALLOWABLE (5 MIN)

MANIFOLD PRESSURE GAGE

14 TO 45 IN. HG
NORMAL OPERATING RANGE

45 TO 48 IN. HG CAUTIONARY
(AVOID CONTINUOUS OPERATION)

48 IN. HG
MAXIMUM ALLOWABLE (5 MIN)

CYLINDER HEAD TEMPERATURE

121° TO 232°C NORMAL

246°C MAXIMUM

CARBURETOR AIR TEMPERATURE

49° TO 74°C
PERMISSIBLE OPERATING RANGE.
55° TO 60°C RECOMMENDED WHEN
OPERATING IN REGIONS OF
VISIBLE MOISTURE.

74°C MAXIMUM
(DANGER OF DETONATION)

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Figure 5-1. Instrument Markings (sheet 1 of 2)

ENGINE GAGE UNIT

OIL TEMPERATURE

38°C MINIMUM IN FLIGHT

38° TO 113°C
NORMAL OPERATING RANGE

113°C MAXIMUM

OIL PRESSURE

25 PSI MINIMUM (IDLING)

65 TO 85 PSI NORMAL
OPERATING RANGE

85 PSI MAXIMUM

NOTE

SINCE ATMOSPHERIC CONDITIONS MAY INFLUENCE OIL PRESSURE, A MINIMUM PRESSURE OF 50 PSI AT CRUISE OR MAXIMUM PRESSURE OF 100 PSI ON TAKEOFF MAY BE EXPERIENCED. ALTHOUGH THE ABOVE PRESSURES ARE NOT THE DESIRED PRESSURES, CONTINUED ENGINE OPERATION AT THE LOWER OR HIGHER PRESSURES IS NOT DETRIMENTAL TO THE ENGINE PROVIDING OIL TEMPERATURE LIMITS ARE NOT EXCEEDED.

FUEL PRESSURE

9 PSI MINIMUM

11 TO 13 PSI
NORMAL OPERATING RANGE

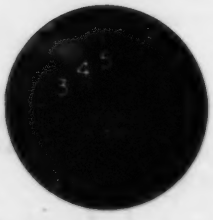
15 PSI MAXIMUM

* AIRSPEED

130 KNOTS IAS-
LANDING GEAR AND WING FLAPS-DOWN
LIMIT AIRSPEED

230 KNOTS IAS-
MAXIMUM ALLOWABLE AIRSPEED UNDER
ALL CONDITIONS.

* THE INSTRUMENT IS MARKED AT THE LIMIT CALIBRATED AIRSPEED THE INDICATED AISPEED LIMITS AS STATED SHALL BE OBSERVED.



SUCTION (VACUUM)

3.75 IN. HG MINIMUM

3.75 TO 4.25 IN. HG
NORMAL OPERATING RANGE

4.6 IN. HG MAXIMUM

DEICER PRESSURE GAGE

12 PSI MINIMUM

12 TO 17 PSI
NORMAL OPERATING RANGE

17 PSI MAXIMUM

AP 001991.2

Figure 5-1. Instrument Markings (sheet 2 of 2)

RPM limitation, although it exceeds the engine overspeed limitation of 3600 RPM, must be observed. Overspeed beyond the engine limits and above 3750 RPM will result in the need for replacement of both the propeller and the engine.

5-9. Starter Limitations.

If the engine has not started after 45 seconds of continuous cranking, allow the starter to cool for 3 minutes before attempting another start.

Section III. POWER LIMITS

5-10. Engine Limitations.

a. Due to the high horsepower-to-displacement ratio of the engine resulting from the high pressure produced by the superchargers, failure to handle the engines correctly will result in serious engine damage. As with any supercharged engine, there is a definite and critical relationship between engine RPM and allowable manifold pressures. These relationships are shown in figure 5-2. Operating the engines at manifold pressures higher than those given for the relative engine speeds will produce detonation. Ground operation must be performed with the propeller levers in LOW PITCH (full forward), except during propeller checks.

b. Supercharged engines produce more heat than unsupercharged engines; therefore, engine temperatures must be watched closely and every precaution taken to see that temperatures do not become excessive, since the risk of detonation increases with engine temperatures.

c. Always open and close the throttles slowly and smoothly. Sudden acceleration and deceleration can impose excessive loads on the supercharger gear train. Sudden or abrupt opening of the throttles, even with the propellers in LOW PITCH, can produce excessive engine pressures and detonation.

d. For an unsupercharged engine, maximum allowable power, at least for a short time, is usually the maximum power the engine will produce; i.e., full throttle and maximum RPM, at sea level. However, with a supercharged engine such is not the case. Extending the range of altitudes at which maximum allowable power is available results in an available power in excess of the allowable maximum, when operating at low altitudes. The operation of supercharged engines thus must receive additional care to make certain that the engine's limitations are not exceeded when operating below the critical altitude. The engine limitations shown in figure 5-2 should become firmly fixed in the pilot's mind, since they show the relationship of manifold pressure and RPM settings to cylinder pressures. Settings in excess of the limit line will result in detonation or excessive engine loads which can result in engine failure.

5-11. Engine Overspeed and Overboost.

The red radial lines on the tachometer and manifold pressure gages represent limits which should not be exceeded in the operation of the engine. Any period of operation beyond these limits enhances the possibility of serious engine damage and eventual failure. Because of this, any overspeed or overboost condition shall be carefully noted and entered in DA Form 2408-13 so that appropriate maintenance action may be taken to prevent the loss of an engine in flight. If engine RPM reaches the range of 3510 to 3600 RPM, the engine shall be inspected for possible damage. If 3600 RPM is exceeded, the engine shall be removed. Manifold pressure exceeding the limit lines shown in figure 5-2, constitutes an overboost. Manifold pressure in excess of the limit line will require the following action:

a. Operation between the cruise, climb and takeoff power limits and the mandatory engine inspection limit for periods of less than five seconds requires no action.

b. Operation between the cruise, climb and takeoff power limits and the mandatory engine inspection limit for periods of 5 to 15 seconds requires inspection.

c. Operation between the mandatory inspection line and the mandatory removal line for periods of less than 15 seconds requires inspection.

d. Overboost of any magnitude for periods in excess of 15 seconds or any operation above the mandatory removal line requires engine replacement.

GREEN
RED

ENGINE OVERBOOST LIMITATIONS

ENGINE OVERBOOST LIMITATIONS
U-8D, U-8G, RU-8D
O-480-1

EXAMPLE

WANTED

ENGINE CONDITION AFTER OVERBOOST

KNOWN

PRESSURE ALTITUDE = 12,000 FT
MANIFOLD PRESSURE = 46.5 IN. HG.
ENGINE RPM = 3000

METHOD

ENTER MANIFOLD PRESSURE HERE
MOVE RIGHT TO PRESSURE ALTITUDE
FOLLOW GUIDE LINES TO REFERENCE LINE
MOVE RIGHT TO ENGINE RPM TO DETERMINE ENGINE CONDITION = MANDATORY ENGINE INSPECTION

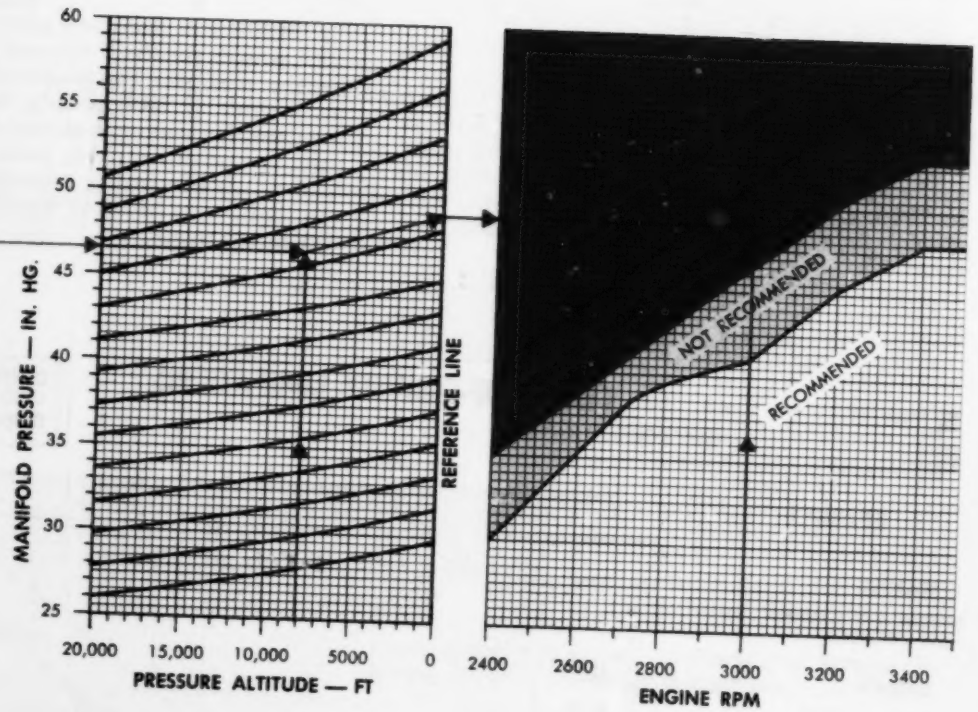


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Figure 5-2. Engine Overboost Limitations

Section IV. LOADING LIMITS

5-12. Loading Limitations.

The center-of-gravity range will remain well within center-of-gravity limits, provided the aircraft loading is accomplished in accordance with Chapter 6.

5-13. Center-of-Gravity Limitations.

a. U-8D U-8G The forward CG limit is 114.0 inches at 5350 pounds or less, progressing uniformly from 114.0 to 118.4 inches from 5350 to 7300 pounds (7350 pounds for the U-8G). The aft CG limit is 124.6 inches at all weights. See figure 5-3.

b. RU-8D The forward CG limit is 118.0 inches at 7000 pounds or less, progressing uniformly from 118.0 to 121.0 inches from 7000 to 7350 pounds. The aft CG limit is 125.6 inches at all weights. See figure 5-4.

5-14. Weight Limitations.

Maximum designed gross takeoff weight is 7300 pounds for the U-8D, and 7350 pounds for the U-8G and RU-8D. The maximum landing weight for all aircraft is 7000 pounds. Space provisions are available for loading in excess of this amount; therefore, limitations of fuel, passengers, and baggage loading are necessarily dependent on each other if the flight is to be made within the designed gross weight of the aircraft.

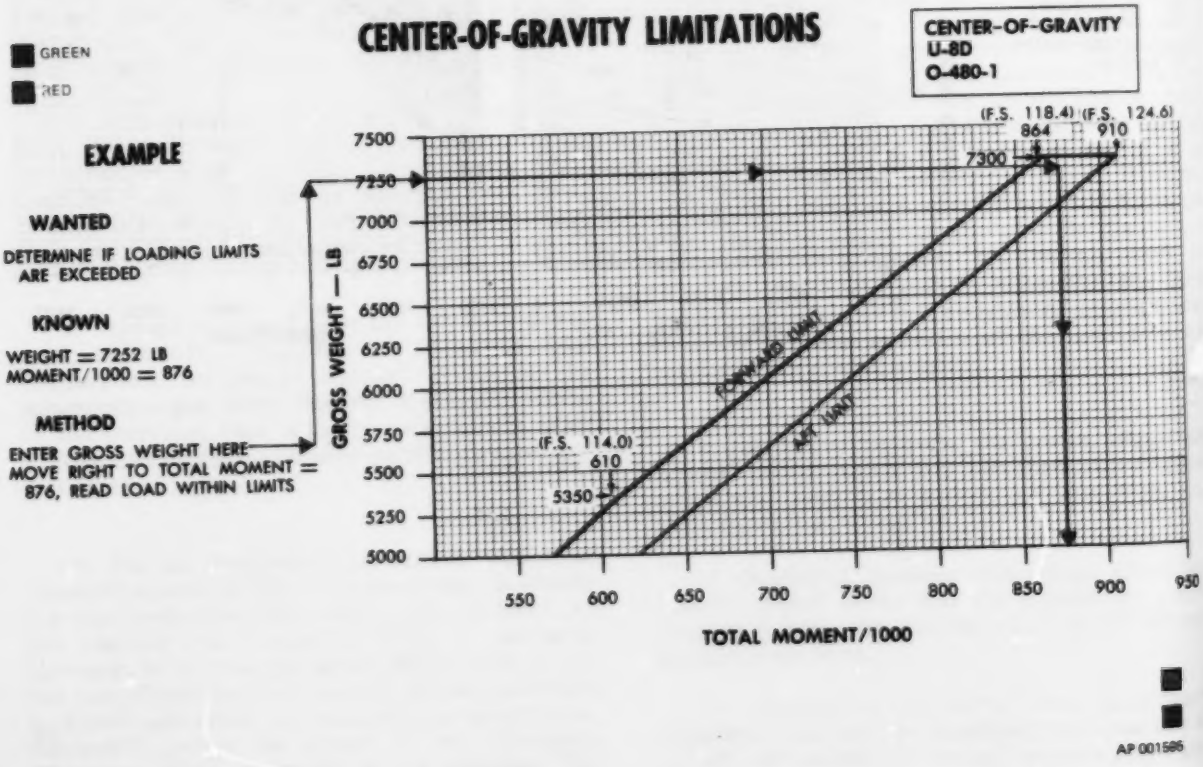


Figure 5-3. Center-of-Gravity Limitations U-8D

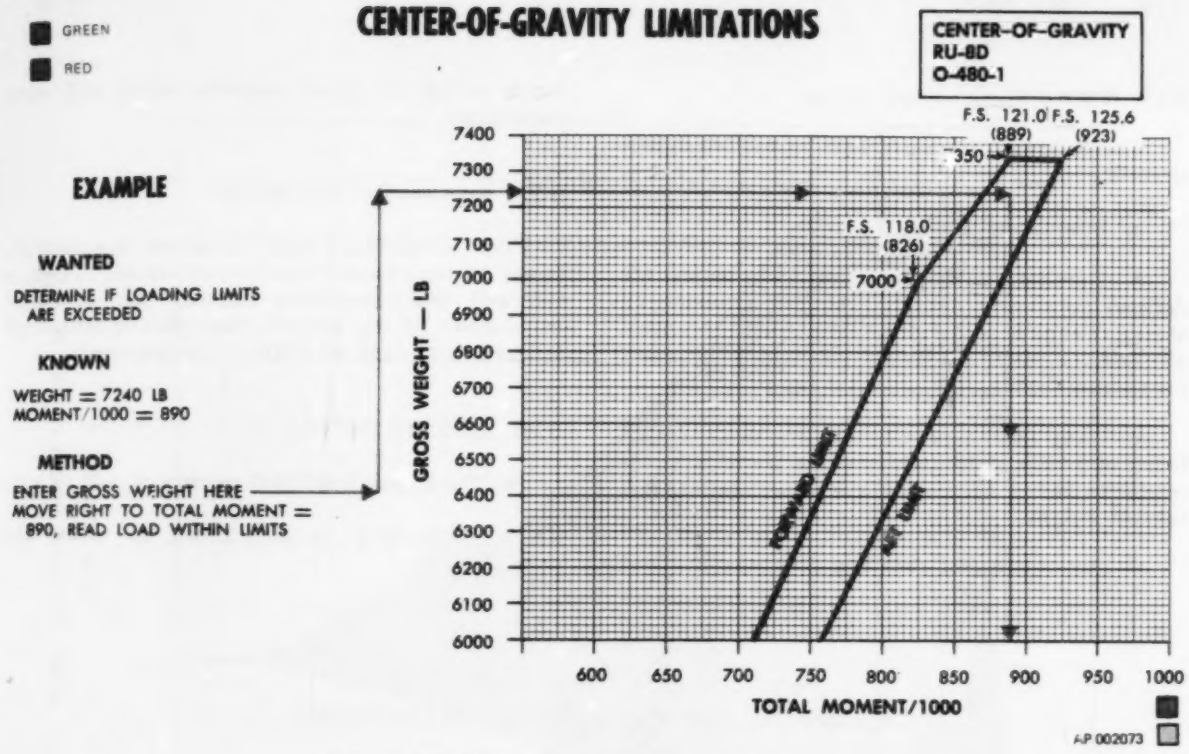


Figure 5-4. Center-of-Gravity Limitations RU-8D

Section V. AIRSPEED LIMITS

5-15. Airspeed Limitations.

Airspeed indicator readings contained in procedures, text, and illustrations throughout the Operators Manual are given as indicated airspeed (IAS). Airspeed indicator markings (figure 5-1) are calibrated airspeed. Airspeed position correction error depends on wing flap position. Refer to the Airspeed Calibration Chart in Chapter 7.

5-16. Maximum Allowable Airspeed.

The maximum allowable airspeed under all conditions is 230 KIAS. See figure 5-5 for limiting airspeed at maximum gross weight under various configurations, and Chapter 8, Section IV for recommended turbulent air penetration speeds.

5-17. Landing Gear Speed.

The airspeed limit for lowering or retracting the landing gear is 130 KIAS. If the landing gear is lowered above this speed, air loads may damage the fairing doors or operating mechanism.

5-18. Wing Flap Speed.

The limiting airspeed for lowering or retracting the wing flaps is 130 KIAS. If the wing flaps are lowered above this limiting airspeed, the fairings or flap operating mechanisms may be damaged.

5-19. Pilot's Storm Window.

The maximum allowable airspeed for opening the pilot's storm window is 125 KIAS.

5-20. Minimum Single-Engine Control Speed (Vmc)

Refer to Chapter 7, Section IX for minimum single-engine control airspeed.

Section VI. MANEUVERING LIMITS

5-21. Maneuvers.

The following maneuvers are prohibited in this aircraft:

a. Intentional spins.

b. Aerobatics of any kind. Aerobatics are defined as an intentional maneuver involving an abrupt change in an aircraft's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight.

c. Any maneuver resulting in a positive load factor of 4.4 G's U-8D and U-8G, 3.5 G's RU-8D or a negative factor of 1.76 G's at maximum gross takeoff weight.

d. Any maneuver resulting in a positive load factor of 2.0 G's or any negative factor with wi flaps down.

5-22. Acceleration Limitations.

The accelerating load limits on the aircraf based on structural limitations are shown in figur 5-5 and 5-6. Operation beyond the structur capabilities of the aircraft will result in structur failure of one or more airframe components.

5-23. Bank and Pitch Limits.

a. Bank limit is 60° left or right.

b. Pitch limit is 30° above or below th horizon.

Section VII. ENVIRONMENTAL RESTRICTIONS

5-24. Flight Under IMC (Instrument Meteorological Conditions).

These aircraft are qualified for flight under instrument conditions.

5-25. Wind Limitations.

CAUTION

When the RU-8D is in a mission antenna configuration, maximum bank angle for crosswind landing is 5 degrees.

Refer to Chapter 7 for wind limitations. Prim consideration must be given to the skill an experience level of individual pilots.

5-26. Maximum Safe Penetration Speed.

The maximum safe penetration speed in sever turbulence is 160 KIAS.

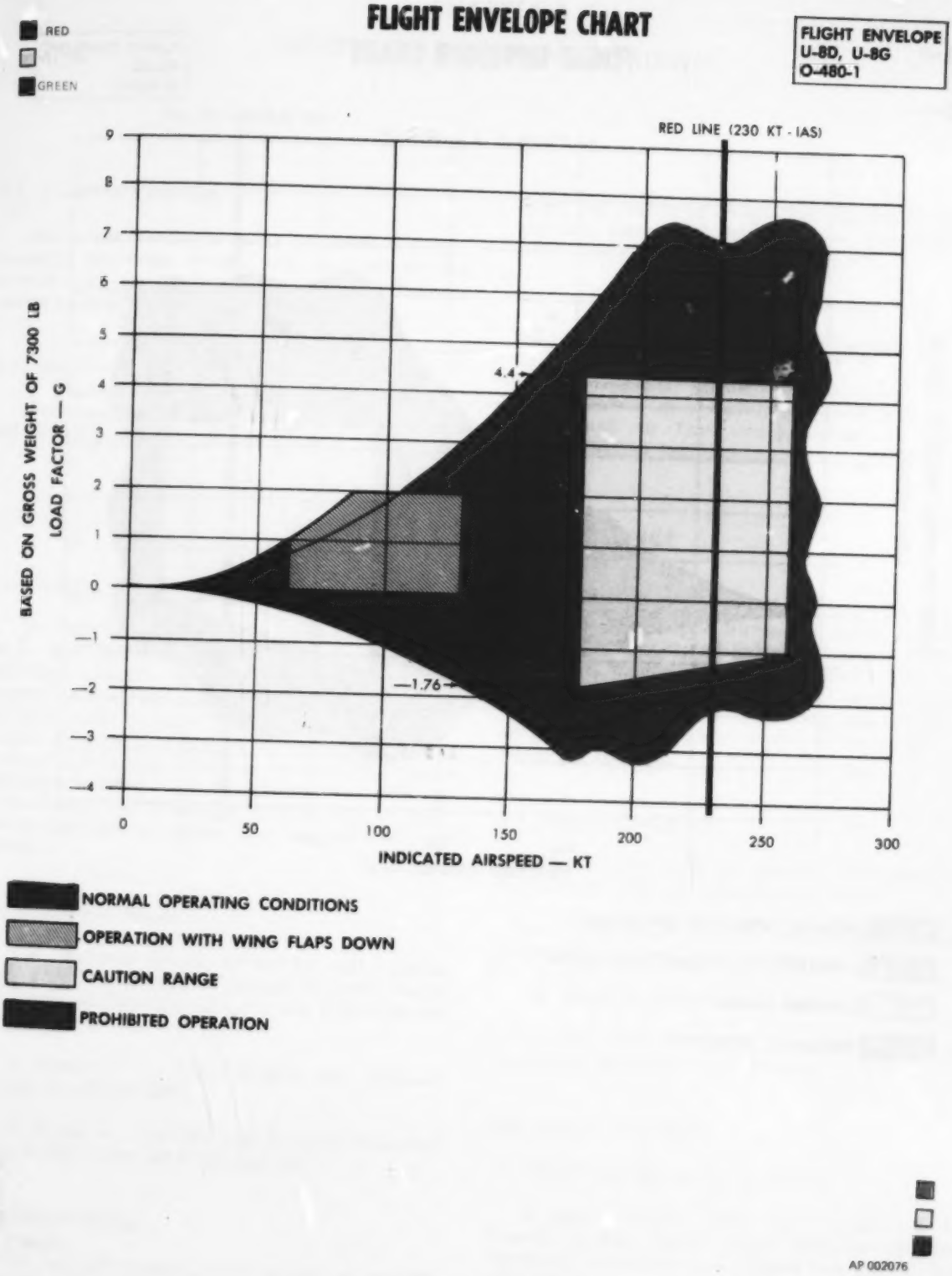


Figure 5-5. Flight Envelope Chart (U-8D U-8G)

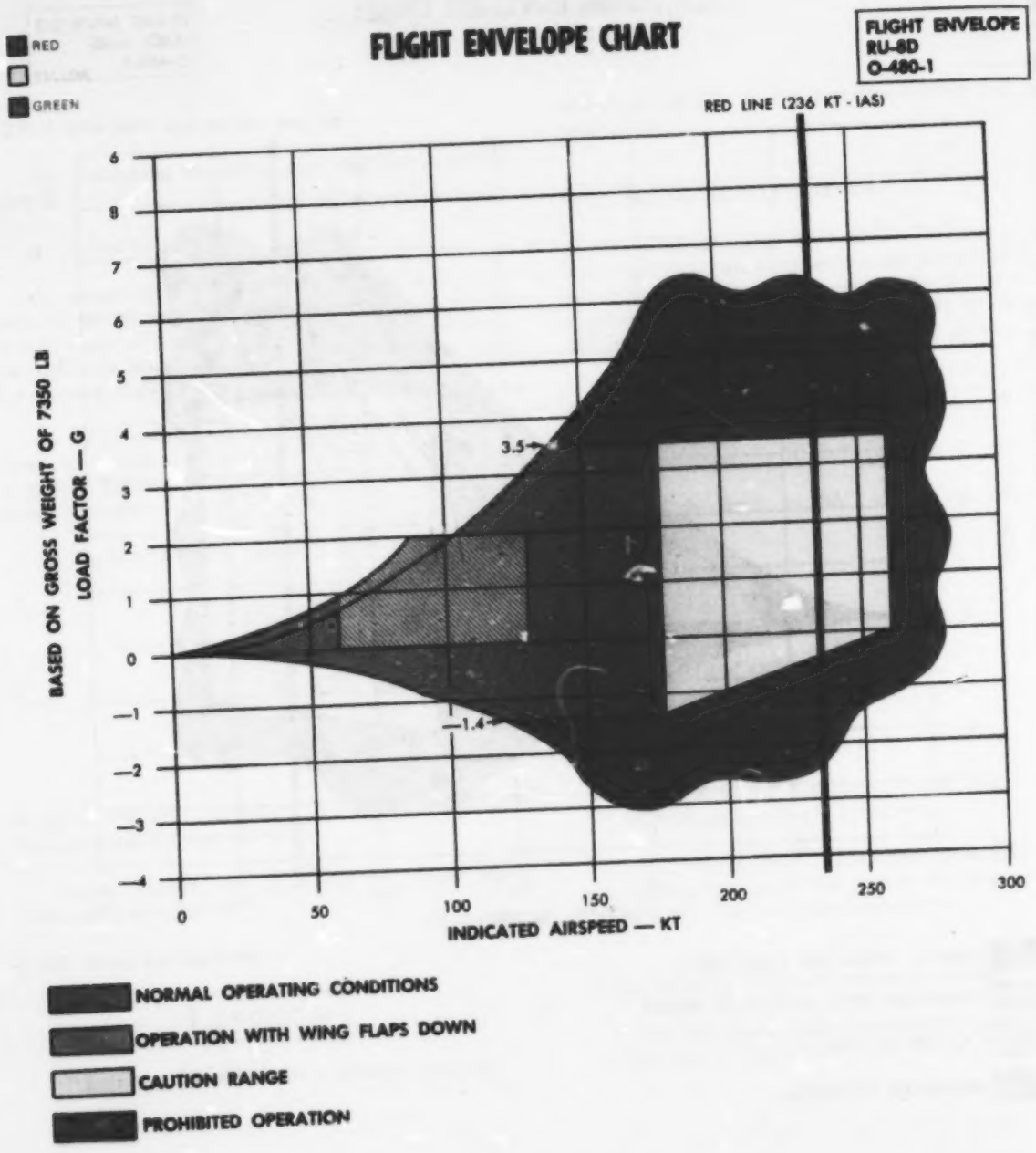


Figure 5-6. Flight Envelope Chart (RU-8D)

CHAPTER 6

WEIGHT/BALANCE AND LOADING

Section I. GENERAL

6-1. Extent of Coverage.

Sufficient data has been provided so that, knowing the basic weight and moment of the aircraft, any combination of weight and balance can be computed.

6-2. Class.

For the purpose of clarity, Army U-8D, U-8G, and RU-8D aircraft are in Class I. Additional directives governing weight and balance of Class I aircraft forms and records, are contained in AR95-16 and TM 55-405-9.

6-3. Aircraft Compartments and Stations.

A diagram (figure 6-1) showing aircraft compartments and stations is provided to aid personnel in the computation of aircraft Weight/Balance and Loading.

Section II. WEIGHT AND BALANCE

6-4. Purpose.

The data to be inserted on weight and balance charts and forms are applicable only to the individual aircraft, the serial number of which appears on the title page of the booklet entitled WEIGHT AND BALANCE DATA supplied by the aircraft manufacturer and on the various forms and charts which remain with the aircraft. The charts and forms referred to in this chapter may differ in nomenclature and arrangement from time to time, but the principle on which they are based will not change.

6-5. Charts and Forms.

The standard system of weight and balance control require the use of several different charts and forms. Within this Chapter, the following are used:

a. Chart C — Basic Weight and Balance Record, DD Form 365C.

b. Form F — Weight and Balance Clearance Form F, DD Form 365F (Transport).

6-6. Responsibility.

The aircraft manufacturer inserts all aircraft identifying data on the title page of the booklet entitled WEIGHT AND BALANCE DATA and on the various charts and forms. All charts, including one sample Weight and Balance Clearance Form F, if applicable, are completed at time of delivery. This record is the basic weight and balance data of the aircraft at delivery. All subsequent changes in weight and balance are compiled by the weight and balance technician.

6-7. Aircraft Weighings.

The aircraft must be weighed periodically as required by pertinent directives or when:

a. The pilot reports unsatisfactory flight characteristics (nose or tail heaviness).

b. Major modifications or repairs are made.

c. The basic weight data contained in the records are suspected to be in error.

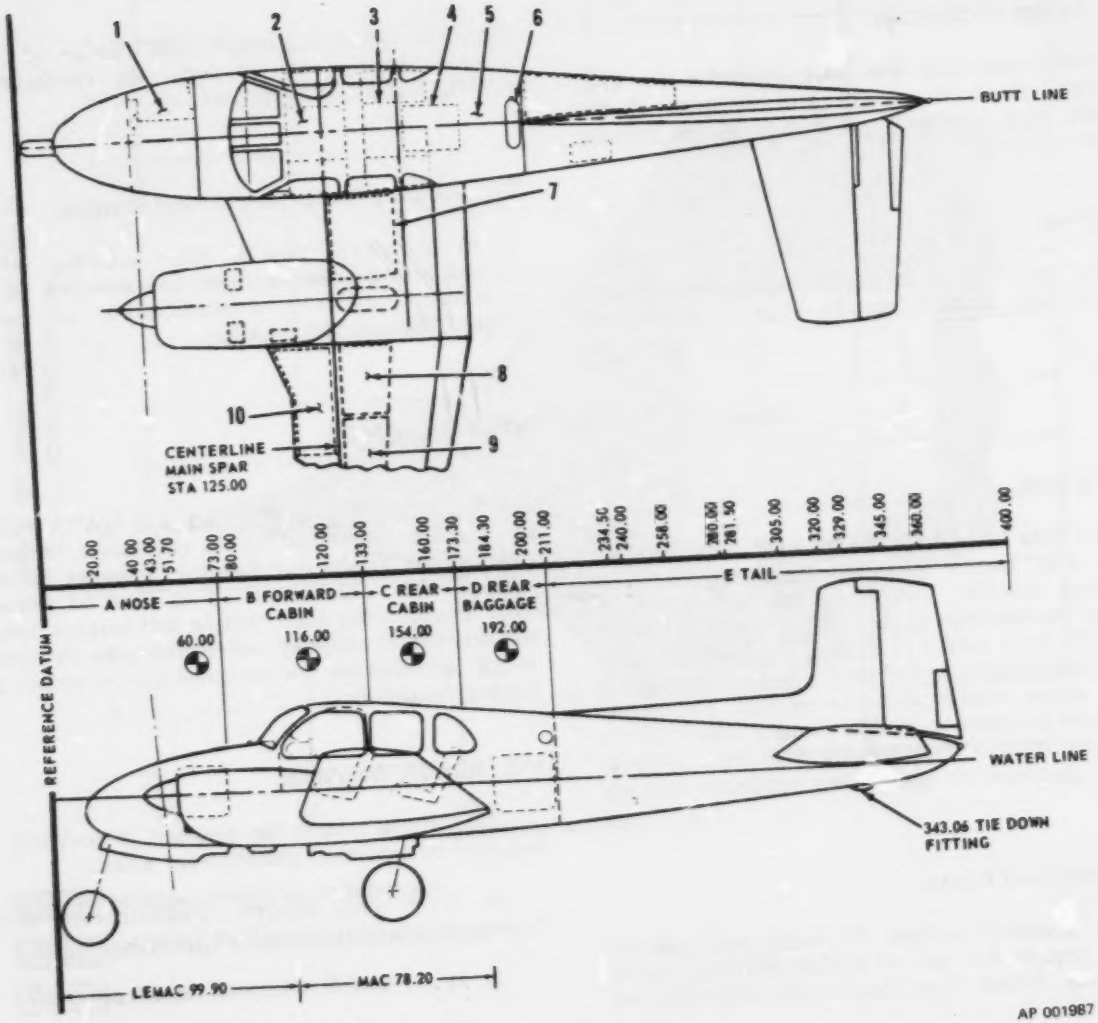
6-8. Weight Definitions.

Weight definitions are as follows:

a. Basic Weight. The basic weight of an aircraft is that weight which includes all fixed operating equipment and trapped fuel and oil. It is only necessary to add variable and expendable load items for various missions. The basic weight of an

NOTE

SPECIFIC MISSION EQUIPMENT INSTALLATIONS AND INDIVIDUAL AIRCRAFT CONFIGURATION DIFFERENCES MAKE COMPLETE MODEL COVERAGE IMPRACTICAL RELATIVE TO CHART E DATA. FOR THIS REASON, U-8D AIRCRAFT LIMITATIONS, CAPACITIES, DIMENSIONS, AND EQUIPMENT LISTINGS ARE CONSIDERED TYPICAL FOR THE U-8G AND RU-8D AIRCRAFT.



DENOTES COMPARTMENT CENTROID

1. Nose compartment
2. Pilot, copilot and forward passenger seats
3. Conventional three-place seat or reclining chair and couch or rearward facing photographer chair
4. Camera location (photographic aircraft)
5. Rear baggage area
6. Oxygen cylinders
7. Main fuel tanks (44 gallons each)
8. Auxiliary fuel tanks (23 gallons each)
9. Auxiliary fuel tanks (25 gallons each)
10. Auxiliary fuel tanks (23 gallons each)

Figure 6-1. Aircraft Compartment and Station

aircraft varies wih structural modifications and changes in fixed operating equipment. The term basic weight, when qualified with a word indicating the type of missions such as Basic Weight for Combat, Basic Weight for Ferry etc., may be used in conjunction with directives stating what the equipment shall be for these missions. For example, extra fuel tanks and various items of equipment installed for long range ferry flight which are not normally carried on combat missions will be included in Basic Weight for Ferry but not in Basic Weight for Combat.

b. Operating Weight. The operating weight is the basic weight of the aircraft, including the crew and all equipment required for the mission, but not including fuel or payload.

c. Gross Weight. The gross weight is the total weight of an aircraft and its contents.

(1) The takeoff gross weight is the operating weight plus the variable and expendable load items which vary with the mission.

(2) The landing gross weight is the takeoff gross weight minus the expended load items.

6-9. Balance Definitions.

Balance definitions are as follows:

a. Reference Datum. The reference datum is an imaginary vertical plane at, or forward of, the nose of the aircraft from which all horizontal distances are measured for balance purposes. Diagrams of each aircraft show this reference datum as balance station zero.

b. Arm. Arm, for balance purposes, is the horizontal distance in inches from the reference datum to the center-of-gravity of the item. Arms may be determined from the Aircraft Compartment and Station Diagram (figure 6-1). For these aircraft arm and fuselage station are the same.

c. Moment. Moment is the weight of an item multiplied by its arm. Moment divided by a constant is generally used to simplify balance calculations by reducing the number of digits. For this aircraft, inches and moment/1000 have been used.

d. Average Arm. Average arm is the arm obtained by adding the weights and adding the moments of a number of items and dividing the total moment by the total weight.

e. Basic Moment. Basic moment is the sum of the moments of all items making up the basic weight. When using data from an actual weighing of an aircraft, the basic moment is the total moment of the basic aircraft with respect to the reference datum.

f. Center-of-Gravity (CG). Center-of-gravity is the point about which an aircraft would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the gross weight of the aircraft.

g. CG Limits. CG limits are the extremes of movement which the CG can have without making the aircraft unsafe to fly. The CG of the loaded aircraft must be within these limits at takeoff, in the air, and on landing.

6-10. Chart C — Basic Weight and Balance Record.

Chart C is a continuous history of the basic weight and moment resulting from structural and equipment changes made in service. At all times, the last weight and moment/100 entry is considered the current weight and balance status of the basic aircraft (figure 6-2).

6-11. Weight and Balance Clearance Form F, DD Form 365F (Transport).

Form F is a summary of the actual disposition of load in the aircraft. It records the balance status of the aircraft step by step. It serves as a work sheet to record weight and balance calculations and any corrections that must be made to insure that the aircraft will be within weight and CG limits. It is necessary to complete a Form F prior to flight when an aircraft is loaded in a manner for which no previous valid Form F is available. A copy must remain in the aircraft for the duration of the flight. A sample of Form F (Transport) is shown in figure 6-3. The form is completed as follows:

1. Insert necessary information at top of form. In blank spaces of LIMITATIONS table, enter gross weights for takeoff and landing obtained from the WEIGHT LIMITATIONS in Chapter 5.

2. Ref 1. Enter aircraft basic weight and mom/1000 figure. Obtain these figures from latest entry on Chart C. Figure 6-2 provides a sample Chart C.

3. Ref 2. Enter amount, weight and mom/1000 figure for oil. Obtain these figures from the Oil Data in Section V — FUEL/OIL.

CHART C — BASIC WEIGHT AND BALANCE RECORD

(Continuous History of Changes in Structure or Equipment Affecting Weight and Balance)

For Use in T.O. 1-1B-40 & AN 01-1B-40

PAGE NO. 1

AIRPLANE MODEL: U-8 | SERIAL NO.: 00-0000

DATE	ITEM NO. IN	ITEM NO. OUT	DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE ADDED (+) WEIGHT	ARM	MOMENT[1] / 1000	WEIGHT CHANGE REMOVED (−) WEIGHT	ARM	MOMENT[1] / 1000	RUNNING TOTAL BASIC AIRPLANE WEIGHT	MOMENT[1] / 1000	INDEX[2]
3-23-61			Basic Weight – Actual							5272	787	
8-10-61		A-8	17L-4 VHF Transmitter				29	48	1.4			
8-10-61		A-9	350 J-3 Mount				3	48	0.1			
8-15-61	A-10		RT-349/ARC-55 Transceiver	58	50	2.9						
8-15-61	A-11		MT-1536/ARC-55 Mount	3	50	0.2				5301	789	

SAMPLE

[1] *Enter constant used below line.* [2] *Balance computer index.*

DD FORM 1 SEPT 54 365C — Previous editions of this form may be used until stocks are exhausted.

AP 001851

Figure 6-2. Chart C - Basic Weight and Balance

WEIGHT AND BALANCE CLEARANCE FORM F
TRANSPORT
(USE REVERSE FOR TACTICAL MISSIONS)

Cross Reference: RAF Form 2870 / RCAF Form F 113 C / SOM 5-51 (USG) — FOR USE IN TM 55-405-9

DATE	AIRPLANE TYPE	FROM	HOME STATION
1 July 1968	U-8D	Fort X	Fort X
MISSION/TRIP/FLIGHT/NO.	**SERIAL NO**	**TO**	**PILOT**
Training	00-0000	Fort Y	Smith, R.

LIMITATIONS			
CONDITION	TAKEOFF	LANDING	LIMITING WING FUEL
¹ALLOWABLE GROSS WEIGHT	7300	7000	7000
TOTAL AIRPLANE WEIGHT (*Ref. 11*)	6830		
OPERATING WEIGHT PLUS ESTIMATED LANDING FUEL WEIGHT		6100	
OPERATING WEIGHT (*Ref. 8*)			5450
ALLOWABLE LOAD (*Ref. 18; use SMALLEST figure*)	470	900	1550
¹PERMISSIBLE C. G. TAKEOFF	FROM 23.7%	TO (% M.A.C.) 31.6%	
¹PERMISSIBLE C. G. LANDING	FROM 22.8%	TO (% M.A.C.) 31.6%	
¹LANDING FUEL WEIGHT	180		

REF	ITEM	WEIGHT	INDEX OR MOM/1000
1	BASIC AIRPLANE (*From Chart C*)	4950	562
2	OIL (8 Gal)	60	6
3	CREW (No. 2)	400	46
4	CREW'S BAGGAGE	40	8
5	STEWARD'S EQUIPMENT		
6	EMERGENCY EQUIPMENT		
7	EXTRA EQUIPMENT		
8	OPERATING WEIGHT	5450	622
9	TAKEOFF FUEL (230 Gal)	1380	184
10	WATER INJ. FLUID (Gal)		
11	TOTAL AIRPLANE WEIGHT	6830	806

12 DISTRIBUTION OF ALLOWABLE LOAD (PAYLOAD)

COMPT	UPPER COMPARTMENTS PASSENGERS NO.	PASSENGERS WEIGHT	CARGO	COMPT	LOWER COMPARTMENTS PASSENGERS NO.	PASSENGERS WEIGHT	CARGO	WEIGHT	INDEX OR MOM/1000
A									
B									
C	2	400						400	62
D			70					70	14
E									
F									
G									
H									
I									
J									
K									
L									
M									
O									
P									
FWD	BELLY								
AFT	BELLY								

REMARKS

Main & Auxiliary Fuel Tanks Full At Take-Off

Estimated 30 Gallons Fuel For Landing

SAMPLE

TOTAL FREIGHT	
TOTAL MAIL	
COMPUTER PLATE NUMBER (*If used*)	CHART E

¹ *Enter constant used*
¹ *Enter values from current applicable T. O.*
¹ *Applicable to gross weight (Ref. 13)*
¹ *Applicable to gross weight (Ref. 18)*
¹ *Ref. 9 minus Ref. 17*

CORRECTIONS (*Ref. 14*)

COMPT	ITEM	CHANGES (+ or −) WEIGHT	¹INDEX OR MOM
TOTAL WEIGHT REMOVED		−	−
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE (*Ref. 14*)			

REF		WEIGHT	INDEX OR MOM/1000
13	TAKEOFF CONDITION (*Uncorrected*)	7300	882
14	CORRECTIONS (*If required*)		
15	TAKEOFF CONDITION (*Corrected*)	7300	882
16	TAKEOFF C. G. IN % M. A. C.	26.7%	
17	LESS FUEL	1200	159
18	LESS AIR SUPPLY LOAD DROPPED		
19	MISC. VARIABLES		
20	ESTIMATED LANDING CONDITION	6100	723
21	ESTIMATED LANDING C. G. IN % M. A. C.	23.8%	

COMPUTED BY: Robert Smith, Capt. (SIGNATURE)

WEIGHT AND BALANCE AUTHORITY: Robert Smith, Capt. (SIGNATURE)

PILOT: Robert Smith, Capt. (SIGNATURE)

DD FORM 1 SEPT 54 365F

16-67910-3 U.S. GOVERNMENT PRINTING OFFICE

AP 001852

NOTE.—THIS TRANSPORT CLEARANCE FORM HAS RESULTED FROM TRIPARTITE AGREEMENT AND NO FURTHER CHANGES MAY BE MADE TO IT WITHOUT PRIOR CONSIDERATION BY TRIPARTITE AUTHORITIES.

Figure 6-3. Weight and Balance Clearance Form F, DD Form 365F (Transport)

4. Ref 3. Using compartment letter designations as shown in the Aircraft Compartment and Station Diagram (figure 6-1), enter number, weight and mom/1000 figures of crew at their takeoff positions. Use actual crew weights if available. Use appropriate values from Personnel Moment Chart (figure 6-5).

5. Ref 4. Enter weight and mom/1000 figures for crew's baggage. Use Cargo Moment Chart (figure 6-7) with weight and station locations most appropriate for baggage loads.

6. Ref 5. Not applicable to U-8 aircraft.

7. Ref 6. Enter weight and mom/1000 figures for emergency equipment. Use Cargo Moment Chart (figure 6-7) with weight and station locations most appropriate for the emergency equipment loads.

8. Ref 7. Enter weight and mom/1000 figures for any extra equipment. Use Cargo Moment Chart (figure 6-7) with weight and station locations most appropriate for the extra equipment loads.

9. Ref 8. Enter sum of weights and sum of mom/1000 figures from Ref 1 through Ref 7 inclusive, to obtain the OPERATING WEIGHT and corresponding mom/1000 figure.

10. Ref 9. Enter the number of gallons, weight and mom/1000 figures for takeoff fuel. The weight of fuel used in warm-up and taxiing should not be included. Use Fuel Moment Chart (figure 6-8) to determine fuel weight and mom/1000 figures. Enter the weight and corresponding mom/1000 figure in the corresponding columns of Ref 9. Also, enter a figure for the total fuel gallons known to be in the aircraft within the TAKEOFF FUEL (Gal) line of Ref 9.

11. Ref 10. Not applicable to U-8 aircraft.

12. Ref 11. Enter the sum of weights and the sum of mom/1000 figures from Ref 8 and Ref 9 to obtain TOTAL AIRPLANE WEIGHT.

13. Determine ALLOWABLE LOAD based on takeoff, landing or limiting wing fuel restirctions by use of LIMITATIONS table in upper left corner of form, as follows:

(1) Enter ALLOWABLE GROSS WEIGHT FOR TAKEOFF and LANDING.

(2) Enter TOTAL AIRPLANE WEIGHT (from Ref 11). Estimate fuel to be aboard at time of landing, and add OPERATING WEIGHT (from Ref 8). Enter total in OPERATING WEIGHT PLUS ESTIMATED LANDING FUEL WEIGHT.

(3) Subtract above weights from respective ALLOWABLE GROSS WEIGHT (TAKEOFF, LANDING) to obtain respective ALLOWABLE LOAD. The smallest of these is the ALLOWABLE LOAD, and represents the maximum amount of weight which may be distributed throughout the aircraft in the various compartments without exceeding the limiting gross weight of the aircraft.

14. Ref 12. Using compartment letter designation of Aircraft Compartment and Station Diagram (figure 6-1), enter number, weight and mom/1000 of passengers and cargo (baggage, mail, etc.). Use Cargo Moment Chart (figure 6-7). Use weight and station locations most appropriate for cargo and passenger loads. Enter for each compartment in WEIGHT and mom/1000 columns.

15. Ref 13. Enter WEIGHT and mom/1000 sums of Ref 11 and Ref 12 in appropriate columns opposite TAKEOFF CONDITION (Uncorrected).

16. Check weight figure, Ref 13, against ALLOWABLE GROSS WEIGHT for TAKEOFF in LIMITATIONS table. Check mom/1000 figure opposite Ref 13 by means of the Center-of-Gravity Limits Chart in Chapter 5 to ascertain that indicated CG is within allowable limits.

17. Ref 14. If changes in amounts of distribution of loads are required, indicate the necessary adjustments by proper entries in CORRECTIONS table in lower left corner of form. Enter a brief description of adjustments made in column marked ITEM. Add all weight and moment decreases and insert totals in space opposite TOTAL WEIGHT REMOVED. Add all weight and moment increases and insert totals in space opposite TOTAL WEIGHT ADDED. Subtract smaller from larger of two totals and enter differences (with applicable + or - sign) opposite NET DIFFERENCE.

18. Ref 15. Enter NET DIFFERENCES in Ref 14 and add or subtract from Ref 13. Enter results on Ref 15. Recheck and asure these figures do not exceed allowable limits.

19. Record figure in LIMITATIONS table as follows: In FROM space for PERMISSIBLE C.G. TAKEOFF, enter inches value obtained as follows: Determine inches figure for the weight on Center-of-Gravity Limitations Chart in Chapter 5, and record in the FROM space. Within the TO space for PERMISSIBLE C.G. LANDING, record

the AFT C.G. limit inches figure specified in the Center-of-Gravity Limits Chart in Chapter 5.

20. Ref 16. By referring to the Center-of-Gravity Limits Chart in Chapter 5, determine takeoff C.G. position. Enter this figure in space provided opposite TAKEOFF C.G. in inches. Insure that this position is within the FWD and AFT C.G. limits.

21. Ref 17. Estimate weight of fuel which may be expended before landing. Using Fuel Moment Chart (figure 6-8) estimate the weight and mom/1000 for each tank system individually and add the two figures together. Enter weight and mom/1000 figures in spaces provided.

NOTE

Do not consider reserve fuel as expended, when determining ESTIMATED LANDING CONDITION.

22. Ref 18. Not applicable to U-8 aircraft.

23. Ref 19. Enter weight and mom/1000 figures for MISC VARIABLES to be expended before landing.

24. Ref 20. Enter the differences in weights and mom/1000 figures between Ref 15 and the total Ref 17, 18, and 19.

25. Record figures in LIMITATIONS table as follows: In FROM space for PERMISSIBLE C.G. LANDING, enter inches value obtained as follows: Determine the FWD LIMIT inches figure for the weight on Center-of-Gravity Limitations Chart and record in the FROM space. Within the TO space, record the AFT C.G. in inches.

26. Ref 21. Refer to the Center-of-Gravity Limitations Chart in Chapter 5 to determine the ESTIMATED LANDING C.G. in inches.

27. The necessary signatures must appear at the bottom of the form.

Section III. PERSONNEL

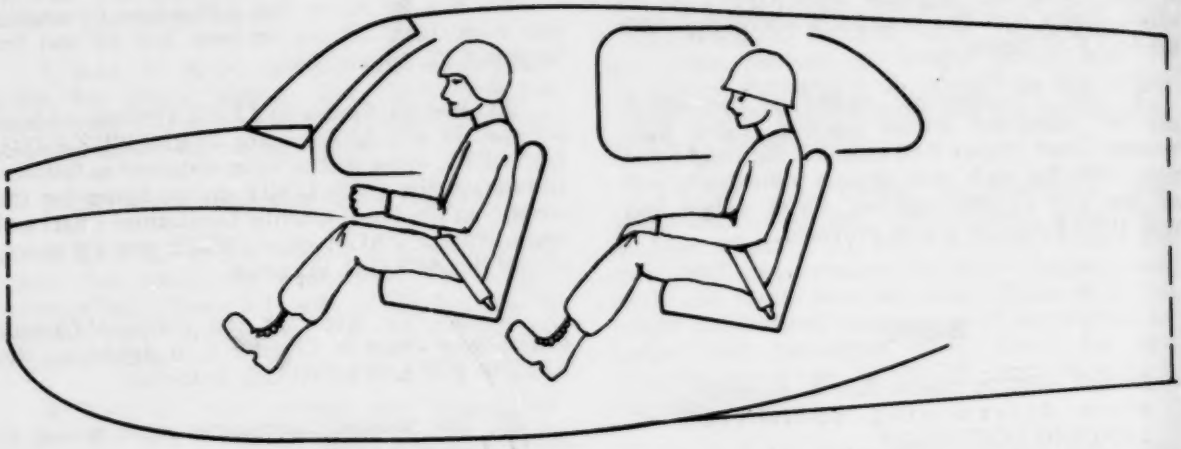
6-12. Personnel Loading.

When aircraft are operated at critical gross weights, the exact weight of each individual occupant plus equipment should be used. If weighing facilities are not available, or if the tactical situation dictates otherwise, loads shall be computed as follows:

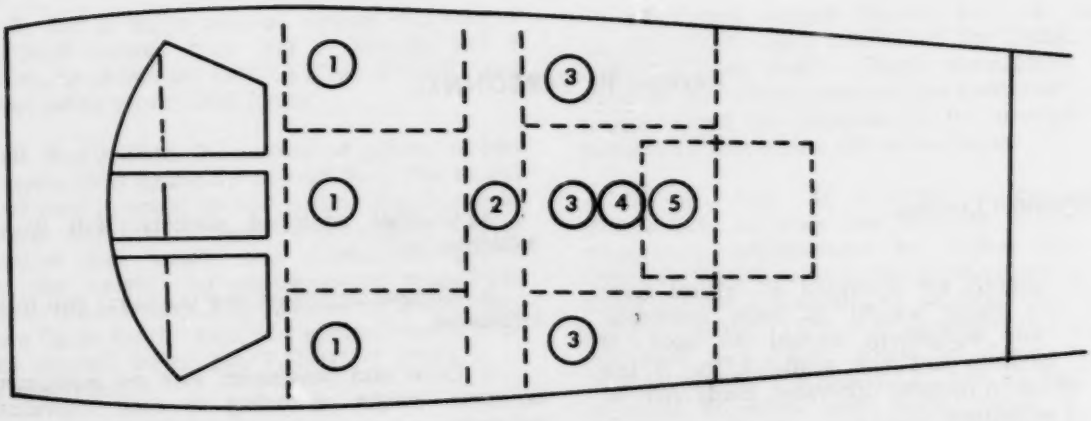
a. Combat equipped soldiers: 240 lb per individual.

b. Combat equipped paratroopers: 260 lb per individual.

c. Crew and passengers with no equipment: compute weight according to each individual's estimate.



STANDARD SEATING ARRANGEMENT



USABLE CABIN AREA	
LENGTH	86 INCHES
WIDTH	54.2 INCHES
HEIGHT	53.2 INCHES
USABLE CARGO AREA	115.0 CUBIC FEET

AP 001990

Figure 6-4. Personnel Loading

GREEN

PERSONNEL MOMENT CHART

PERSONNEL MOMENTS
U-8D
O-480-1

SEAT POSITION: No. 1 PILOT, COPILOT, AND/OR FWD PASSENGER
No. 2 COUCH — FWD PASSENGER
No. 3 STD REAR PASSENGER (THREE PLACE) OR PHOTOGRAPHER
No. 4 COUCH — MID PASSENGER OR RECLINING CHAIR
No. 5 COUCH — AFT PASSENGER

EXAMPLE

WANTED

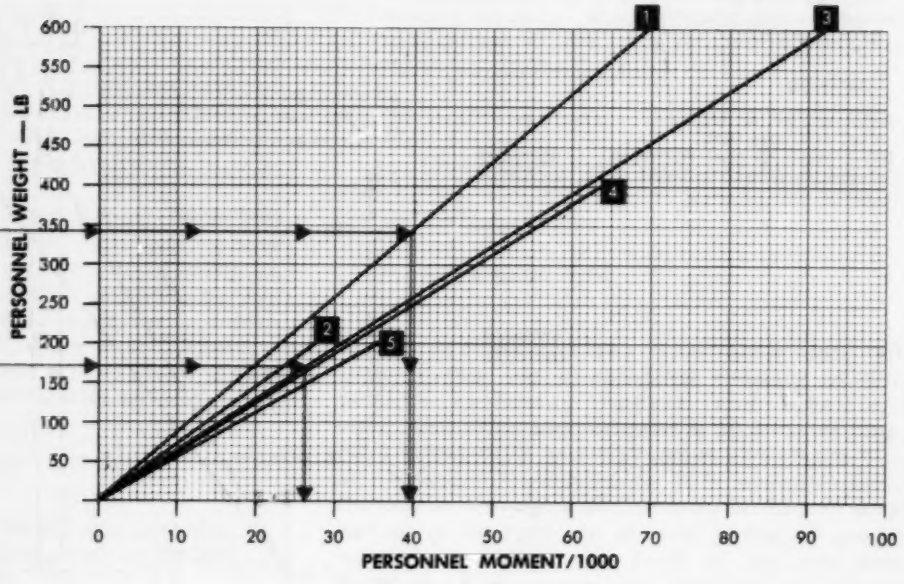
PERSONNEL MOMENT

KNOWN

THREE PASSENGERS
PILOT AND FWD PASSENGER,
WEIGHT = 340 LBS
MOMENT/1000 = 39
REAR PASSENGER
WEIGHT = 170 LBS
MOMENT/1000 = 26

METHOD

ENTER WEIGHT AT EACH SEAT POSITION HERE
MOVE RIGHT TO SEAT POSITION
MOVE DOWN, READ MOMENT = 39 AND 26



AP 001592

Figure 6-5. Personnel Moments Chart U-8D

GREEN

PERSONNEL MOMENT CHART

PERSONNEL MOMENT
RU-8D
O-480-1

EXAMPLE

WANTED

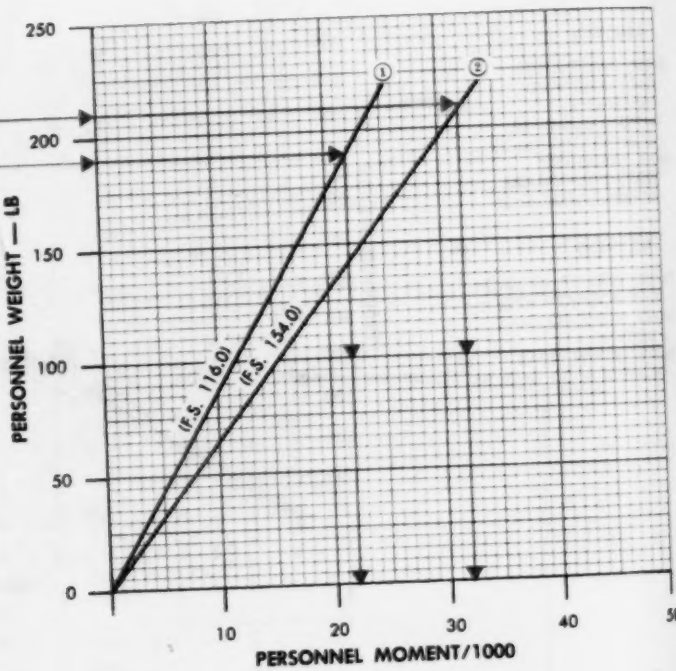
PERSONNEL MOMENT

KNOWN

PILOT WEIGHT = 190 LB
SEAT POSITION 1
RADAR OBSERVER WEIGHT = 210 LB
SEAT POSITION 2

METHOD

ENTER WEIGHT AT EACH SEAT POSITION HERE
MOVE RIGHT TO SEAT POSITIONS
MOVE DOWN, READ MOMENT = 22, 32



AP 002

Figure 6-6. Personnel Moment Chart RU-8D

Section IV. CARGO LOADING

NOTE

On RU-8D aircraft the aft baggage area is occupied by mission equipment installations. No baggage or cargo provisions exist.

6-13. Cargo Area.

a. Forward Compartment.

CAUTION

Cargo which may be affected by heat should not be transported in the forward compartment because of the heat generated by the electronic equipment.

(1) The forward compartment (figure 6-1) contains the radio equipment. Avionics cooling requirements preclude using the compartment for baggage. However, a maximum capacity of 393 pounds, including electronic equipment, heater, and blower, is allowed. It is accessible through a door measuring 21.3 inches by 19.75 inches located on the right side of the nose section.

NOTE

U-8G and RU-8D aircraft are provided with an additional access panel on the left side of the nose section.

(2) The forward compartment is 28.0 inches long, 48.0 inches wide, and 26.6 inches high at maximum measurements, providing 21.0 cubic feet. It does not contain cargo-securing provisions.

b. Cabin.

(1) U-8D. A shelf above and behind the rear seat will support 70 pounds of luggage or cargo when the rear seat is in place. With the rear seat, front passenger seat, and rear floorboard carpeting removed the cabin opens into the aft baggage area, furnishing 115.0 cubic feet of cargo area. The combined cabin and aft baggage area is 86.0 inches long, 54.2 inches wide, and 53.2 inches high at the maximum dimension. Bulkhead 187.00 and the shelf behind the rear seat are not removable, and thus remain an obstruction in the cargo area. This area is accessible through the aft baggage area door and the cabin entrance door. The cabin entrance door is 35 inches high and 36.5 inches wide at maximum dimension. No cargo securing provisions are provided other than the four baggage-securing straps in the aft baggage area. This combined area has a structural floorboard capacity in excess of 1903 pounds.

NOTE

The aircraft is not designed to lift as much weight as the floorboard will support. Gross weight must not exceed 7300 pounds (7350 pounds for RU-8D aircraft) for takeoff or 7000 pounds for landing.

(2) U-8G. The cabin extends from the rear of the pilot and copilot seats to the forward end of the baggage area.

c. Aft Baggage Area.

(1) U-8D. The 43.5 cubic foot aft baggage area has a structural capacity of 360 pounds including oxygen and electronic equipment. This compartment is 50.5 inches long, 53.6 inches wide, and 45.7 inches high (figure 6-1) at maximum measurements. It is accessible from the outside through a 26.5 inch by 26.75 inch door just aft of the right rear window. In flight it can be reached by tilting the back of the rear seat forward. Four straps are provided to secure baggage or light cargo.

(2) U-8G. The aft baggage and light cargo area of the U-8G aircraft extends the full width of the fuselage just behind the cabin entrance. A network of straps with hook fasteners secure the baggage or cargo within the area. The 30 cubic foot area, measuring 47 inches long, 42 inches wide, and 37 inches high at maximum measurements, has a loading capacity of 200 pounds. See figure 6-1 for compartment configuration.

WARNING

The lower shelf shall not be loaded in excess of the 200 pounds placarded limitation. The upper shelf (aft) shall not be loaded in excess of 100 pounds. The shelf is primarily intended for storage of small parcels, briefcases, hats, etc.

GREEN

CARGO MOMENT CHART

CARGO MOMENT
U-8D
O-480-1

EXAMPLE

WANTED

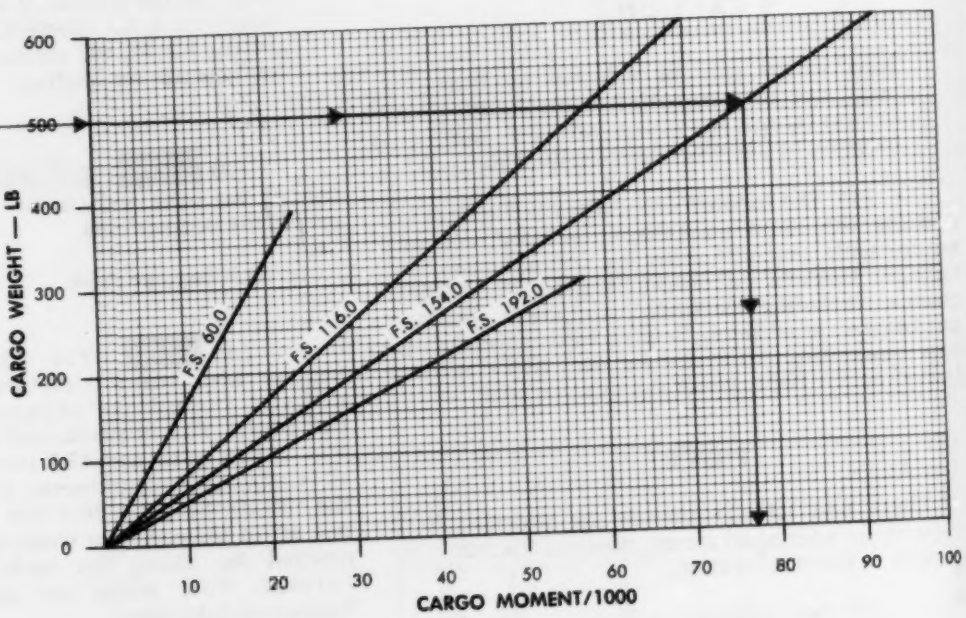
CARGO MOMENT

KNOWN

CARGO WEIGHT = 500 LB
CARGO LOCATION = STA 154.0

METHOD

ENTER WEIGHT OF CARGO HERE
MOVE RIGHT TO CARGO LOCATION
MOVE DOWN, READ MOMENT = 77



AP 002080

Figure 6-7. Cargo Moment U-8D

6-14. Air Cargo Features.

CAUTION

The forward flight center-of-gravity limit is exceeded when the aircraft is stripped for cargo. If it becomes necessary to fly the aircraft without a load while stripped for cargo, a ballast load must be hauled.

The U-8D and U-8G aircraft are capable of light cargo or troop transportation, and may be converted for these missions by removing as many passenger seats as required. The standard passenger seat installation is also used for troop transportation. No cargo loading, unloading, or securing equipment is provided. A wide payload distribution range is available for all aircraft models.

a. Total weight and space capacity of the cargo areas will exceed gross weight limitations on all configurations of the aircraft. Limitations on fuel, passengers, baggage, and cargo are necessarily dependent on each other to stay within the design gross weight limits for safe flight operations.

b. The stability and controllability of the aircraft is improved, particularly at low airspeeds, by loading as close to the optimum center-of-gravity as possible.

6-15. Preparation of General Cargo.

Before loading cargo in the aircraft, the loading personnel should determine such data as weight, dimensions, center-of-gravity, and contact areas of the individual cargo items for use in positioning the load. Refer to Section II, for Weight and Balance information to compute the final load position in the aircraft.

6-16. Preparation of Cabin for Loading.

Prior to loading cargo in the cabin, the passenger seats, carpeting, and window curtains must be removed from the passenger areas. On U-8D aircraft, the right front seat, rear seat, rear seat carpeting, and window curtains are to be removed. On U-8G aircraft, remove the passenger seats, cabin carpeting, and cabin window curtains.

6-17. Cargo Securing Equipment.

The only cargo securing devices are the straps in the aft baggage area. These straps should be secured when baggage or light cargo is carried in the area. The baggage area straps lash across the cargo and are secured with buckles.

6-18. Cargo Center-of-Gravity Planning.

The cargo loading must be planned so that the center-of-gravity of the loaded aircraft will fall within the operating limits given in Chapter 5. The allowable cargo center-of-gravity range is determined by these operating limits. All cargo capacities are based on the aircraft operating weight with all passenger seats removed. The weight and location of passengers and crew members must be considered when determining the cargo center-of-gravity location and cargo weight capacity. The maximum gross weight of the U-8D aircraft is 7300 pounds. The maximum gross weight for U-8G aircraft is 7350 pounds. Maximum landing weight for both aircraft is 7000 pounds. RU-8D aircraft are not used for cargo missions.

6-19. Cargo Center-of-Gravity Computation.

Table 6-1 shows an example of cargo center-of-gravity planning.

6-20. Load Planning.

A thorough check by the pilot before each flight will insure the best loading arrangement. The amount of control surface deflection required to correct for forward or aft CG conditions will restrict maneuverability of the aircraft. The stability and controllability of the aircraft is improved, particularly at low airspeeds, by loading as close to the neutral position as possible. The degree of load planning will vary with each operation, depending on the amount and bulk of the load. The basic factors to be considered in any loading situation are as follows:

a. The location of the cargo must be planned so that the center-of-gravity of the loaded aircraft will be within the operating limits.

b. The total weight of the loaded aircraft must not exceed the maximum allowable gross weight.

c. Cargo must be arranged to permit access to all emergency equipment and exits during flight.

Table 6-1. Center-of-Gravity Location Planning Example

ITEM	WEIGHT	STATION	MOMENT
Aircraft basic weight	4950	113.5	562000
Add: Pilot	200	116.0	23200
Engine oil	60	103.0	6180
Operating weight	5210	113.5	591380
Cargo	200	139.0	27800
Cargo	200	154.0	30800
Cargo	200	158.0	31600
Cargo	100	192.0	19200
Fuel: Main (88 gallons)	528	139.0	73392
Auxiliary (142 gallons)	852	130.0	110760
Takeoff weight	7290	121.4	884932

Note: This chart is for planning purposes only. Final aircraft loading operations and weight and balance computation must be checked for the particular aircraft.

d. Bulk cargo must be properly arranged to prevent damage to fragile items.

e. Floorboard and bulkhead structural capacity must be considered in the loading of heavy or sharp-edged containers and equipment. Secondary supports should be used to distribute highly condensed weights evenly over the cargo areas.

f. Cargo destination should be considered when applicable. If part of the cargo is to be removed at an intermediate stop, the cargo should be arranged accordingly.

g. All cargo must be adequately secured to prevent damage to the aircraft, other cargo, or the item itself.

6-21. Loading Procedure.

CAUTION

The forward flight center-of-gravity limit is exceeded when the aircraft is stripped for cargo. If it becomes necessary to fly the aircraft without a load while stripped for cargo, a ballast load must be hauled.

a. U-8D. Loading of cargo will be accomplished manually using the baggage area doors and the main cabin entrance door only. Extreme caution should be exercised to prevent damaging the wings, wing flaps, doors, floorboards, upholstery, etc. Personnel loading the aircraft should observe wing walks and NO STEP areas. The floorboards are equally stressed to support cargo loads; thus secondary support provisions are not normally required. However, should the weight of an item be concentrated in a small area, a secondary support may be necessary. Cargo loading may be roughly calculated as essentially the same loading as passenger loading, plus seat weight per area. (Front passenger seats weigh 24 pounds and the rear passenger seat weighs 60 pounds.)

b. U-8G Loading of cargo will be accomplished manually using the main cabin entrance door only. Extreme caution should be exercised to prevent damaging the wing flaps, doors, floorboards, seat tracks, upholstery, etc. The floor boards are not stressed to support heavy or concentrated loads. All cargo loaded in the passenger cabin must be supported by the seat tracks. Cargo loaded on either set or both sets of tracks simultaneously must rest on a suitable secondary support, preferably wood planking, to distribute the load and protect the tracks. Cargo should have at least one secondary support on each side of the area. Cargo loading may be roughly calculated as essentially the same loading as passenger loading plus seat weight per area.

6-22. Securing Loads.

Various aircraft maneuvers tend to move the cargo vertically, sideways, forward, rearward, or in any combination of directions. For this reason all

cargo must be secured with restraints strong enough to withstand the maximum force exerted in any direction. The maximum force can be determined by multiplying the weight of cargo item by the applicable load factor. These established load factors (the ratio between the total force and the weight of the cargo item) are 1.5 to the side and rear, 3.0 up, 6.6 down, and 9.0 forward. The only cargo securing devices are the straps in the aft baggage area. These straps should be secured when baggage or light cargo is carried in the area. The baggage straps lash across the cargo and are secured with buckles.

6-23. Cargo Unloading.

Unloading of cargo will be accomplished manually using the baggage area doors and the cabin entrance only. Extreme caution must be exercised to prevent damaging the wings, wing flaps, floorboards, seat tracks, upholstery, etc. Unloading personnel should observe wing walks and NO STEP areas. After completing the unloading operation, check the aircraft for possible damage from loading, transporting, or unloading the cargo; then replace the carpeting, passenger seats, and window curtains as applicable.

Section V. FUEL/OIL

6-24. Fuel Load.

Fuel loading imposes a restriction on the amount of cargo which can be carried. The required fuel must first be determined, then that weight subtracted from the total weight of cargo and fuel. Cargo weights up to and including the remaining allowable capacity can be subtracted directly from the weight of cargo and fuel. As the fuel load is increased, the cargo capacity is reduced.

6-25. Fuel and Oil Data.

a. Fuel Moment Chart. This chart (figure 6-8) shows fuel moment/1000 when the total weight of fuel on the aircraft or the total volume of fuel (grade 100/130 at Standard Day Conditions) are known.

b. Oil Data. The usable oil capacity for both engines is 8.0 gallons (60 pounds). (The unusable oil capacity is part of the basic weight of the aircraft.) The usable oil supply moment/1000 is 6. Oil weight is 7.5 pounds per gallon at Standard Day Conditions.

GREEN

FUEL MOMENT CHART

FUEL MOMENT
U-8D, U-8G, RU-8D
O-480-1

EXAMPLE

WANTED

FUEL MOMENT

KNOWN

FUEL FULL (230 GAL)
MAIN, 88 GAL = 528 LB
MOMENT/1000 = 73
AUX., 142 GAL = 832 LB
MOMENT/1000 = 111

METHOD

ENTER AUX. FUEL HERE
MOVE RIGHT AND DOWN TO MOMENT,
REPEAT FOR MAIN FUEL

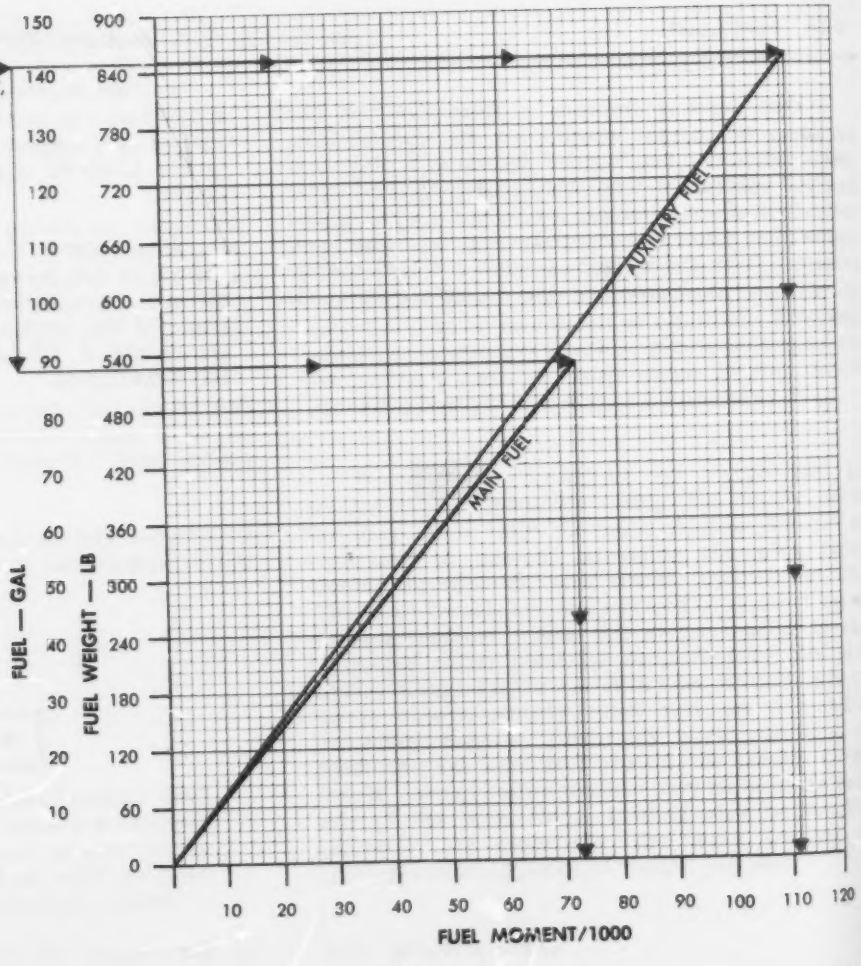


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Figure 6-8. Fuel Moment Chart

CHAPTER 7

PERFORMANCE DATA

Section I. INTRODUCTION

7-1. Description.

The charts presented in this chapter are based on and are consistent with the recommended operating procedures and techniques set forth in other chapters of this manual. The charts contain the performance data necessary for preflight and inflight mission planning. Explanatory text applicable to each type of chart is included to illustrate the use of the data presented.

7-2. Purpose.

a. The purpose of this chapter is to provide the best available performance data for the U-8D, U-8G and RU-8D aircraft. Regular use of this information will enable you to receive maximum safe utilization from the aircraft. Although maximum performance is not always required, regular use of this chapter is recommended for the following reasons:

(1) Knowledge of your performance margin will allow you to make better decisions when unexpected conditions or alternate missions are encountered.

(2) Situations requiring maximum performance will be more readily recognized.

(3) Familiarity with the data will allow performance to be computed more easily and quickly.

(4) Experience will be gained in accurately estimating the effects of variables for which data are not presented.

b. The information is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The data may also be used in flight, to establish unit or area standing operating procedures, and to inform ground commanders of performance/risk tradeoffs.

7-3. General.

The data presented shall cover the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, your judgement and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text accompanying each phase of performance. Where practical, data are presented at conservative conditions. However, **NO GENERAL CONSERVATISM HAS BEEN APPLIED.** All performance data presented are within the applicable limits of the aircraft.

CAUTION

Exceeding operating limits can cause permanent damage to critical components. Overlimit operation can decrease performance, cause immediate failure, or failure on a subsequent flight.

7-4. Limits.

Applicable limits are shown on the charts as red lines. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum value and time above limits on DA Form 2408-13 so proper maintenance action can be taken.

7-5. Chart Explanation.

A complete series of performance charts are provided for U-8D, U-8G and RU-8D aircraft in this manual. These charts furnish the pilot with sufficient data to make an intelligent and safe flight plan. The charts include data on takeoff, climb, landing, and operating instructions for cruising flight from maximum endurance to normal rated power. No allowance has been made for navigational error, formation flight, or other contingencies. Appropriate allowances for these items should be dictated by local regulations and should be accounted for when the fuel available for cruise is determined. The charts are arranged to give maximum facility of use in preflight and inflight planning. All charts are based on ambient temperature conditions and pressure altitude.

7-6. Chapter 7 Index.

SECTION	TITLE	FIGURE NO.	CHART SUBJECT	PAGE NO.
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		7-2	Temperature Conversion/Correction	7-8
		7-3	Airspeed Calibration (U-8D, U-8G)	7-10
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		7-5	Altimeter Correction (U-8D, U-8G)	7-12
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III	Crosswind-Takeoff or Landing	7-7	Crosswind-Takeoff or Landing (U-8D, U-8G)	7-15
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IV	Fuel Flow	7-9	Fuel Flow	7-19
V	Manifold Pressure Available for Takeoff	7-10	Manifold Pressure Available for Takeoff	7-21
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		7-12	Takeoff-Normal (RU-8D)	7-25
VII	Normal Rotation/ Takeoff Airspeed	7-13	Normal Rotation/Takeoff Airspeed (U-8D, U-8G)	7-27
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XI	Operation Envelope	7-21	Operation Envelope (U-8D, U-8G)	7-43
		7-22	Operation Envelope (RU-8D)	7-45
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		7-24	Cruise Climb (RU-8D)	7-49
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		7-26	Cruise FAT 0° and 20° C, SL (U-8D, U-8G)	7-52
		7-27	Cruise FAT 40° C SL (U-8D, U-8G)	7-53
		7-28	Cruise FAT -20° and 0° C, 5000 Ft (U-8D, U-8G)	7-54
		7-29	Cruise FAT 20° C, 5000 Ft (U-8D, U-8G)	7-55
		7-30	Cruise FAT -20° and 0° C, 10,000 Ft (U-8D, U-8G)	7-56
		7-31	Cruise FAT 20° C, 10,000 Ft (U-8D, U-8G)	7-57
		7-32	Cruise FAT -40° and -20° C, 15,000 Ft (U-8D, U-8G)	7-58
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SECTION	TITLE	FIGURE NO.	CHART SUBJECT	PAGE NO.
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XVI	Landing	7-51	Landing (U-8D, U-8G)	7-83
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7-7. Color Coding.

The performance charts are color coded as follows:

a. Green: Example guidelines.

b. Red: Limit lines.

c. Yellow: Precautionary or time-limited operation.

d. Blue: Maximum performance conditions.

7-8. Reading The Charts.

The primary use of each chart is given in an example and a green guideline is provided to help you follow the route through the chart. The use of a straight edge (ruler or page edge) and a hard fine point pencil is recommended to avoid cumulative errors. The majority of the charts provide a standard pattern for use as follows: enter first variable on top left scale, move right to the second variable, reflect down at right angles to the third variable, reflect left at right angles to the fourth variable, reflect down, etc. until the final variable is read out at the final scale. In addition to the primary use, other uses of each chart are explained in the text accompanying each set of performance charts. Colored registration blocks located on the bottom and top of each chart are used to determine if slippage has occured during printing. If slippage has occured, refer to Chapter 5 for correct operating limits.

7-9. Dashed Line Data.

Data beyond conditions for which tests were conducted are shown as dashed lines.

7-10. Data Basis.

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The applicable report and date of the data are also given. The data provided generally is based on one of four categories:

a. Flight Test Data. Data obtained by flight test of the aircraft by experienced flight test

personnel at precise conditions using sensitive calibrated instruments.

b. Derived From Flight Test. Flight test data obtained on a similar rather than the same aircraft and series. Generally small corrections have been made.

c. Calculated Data. Data based on tests, but not on flight test of the complete aircraft.

d. Estimated Data. Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7-11. Specific Conditions.

The data presented is accurate only for specific conditions listed under the title of each chart. Variables for which data is not presented, but which may affect that phase of performance, are discussed in the text. Where data is available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7-12. General Conditions.

The following general conditions might have deteriorating effects on the aircraft performance: atmospheric humidity, fuel flow, rigging, pilot technique, aircraft variation, engine variation, and instrument variation.

7-13. Performance Discrepancies.

Regular use of this chapter will allow you to monitor instrument and other aircraft systems for malfunction, by comparing actual performance with planned performance. Knowledge will also be gained concerning the effects of variables for which data is not provided, thereby increasing the accuracy of performance predictions.

7-14. Definitions of Abbreviations.

Abbreviations used through this chapter are defined as follows:

IAS	Indicated airspeed assuming zero instrument error.
CAS	Calibrated airspeed; IAS corrected for position error.
TAS	True airspeed; CAS corrected for compressability and relative density.
Vmc	Minimum control speed; the speed sufficient to enable the aircraft to maintain a heading: takeoff configuration, dead engine propeller windmilling, with maximum power and 5 degrees bank into live engine.
KT	Knots.
FT	Feet.
NM	Nautical miles.
NAUT	Nautical.
TEMP	Temperature.
FAT	Free air temperature.
°C	Degrees celsius.
°F	Degrees fahrenheit.
RPM	Revolutions per minute.
LB	Pounds.
DEG	Degrees.
in. Hg.	Inches mercury.
HP	Horsepower.
GAL	Gallons.
PSI	Pounds per square inch.
R/C	Rate-of-climb.
SL	Sea Level.
PRESS ALT	Pressure Altitude.
FT/MIN	Feet per minute.
MIN	Minutes.
HR	Hours.
MAX	Maximum.
DN	Down.

Section II. PERFORMANCE PLANNING

7-15. Performance Planning Card.

This card (figure 7-1), is provided to assist the pilot in recording data applicable to the mission and may be reproduced at the local level. The data card provides readily available information for departure, climb, cruise climb, cruise, arrival, and prevailing conditions. Pertinent data required to fill in the blanks on the card shall be computed from the performance charts contained in this chapter, and from existing conditions at time of takeoff or landing. The takeoff and landing data shall be computed prior to takeoff, as a precaution against emergency conditions which could develop after takeoff.

7-16. Performance Planning Sequence.

Completion of the Performance Planning Card is accomplished as follows:

a. Departure.

(1) Determine the following before entering performance charts.

1. Atmospheric Conditions.

(1) Pressure Altitude. Pressure altitude is determined by setting the altimeter to 29.92 and reading pressure altitude, or by adding 100 feet to field elevation for each 0.1 in. Hg. below 29.92, or by subtracting 100 feet from field elevation for each 0.1 in. Hg. above 29.92.

(2) FAT.

(3) Wind (direction/speed).

2. Airport Conditions.

(1) Runway (direction/length/slope).

(2) Obstacles to be cleared (height/distance).

(2) Determine the following from the performance charts.

1. Aircraft Operating Conditions.

(1) Takeoff weight — Either estimated, or determined from the Single-Engine Climb Chart (positive R/C for gear down).

(2) Departure airspeeds — Vmc from the Minimum Single-Engine Control Airspeed Chart (figure 7-17 or 7-18). Rotation, takeoff and obstacle clearance airspeeds from the Normal Rotation/Takeoff Airspeed Chart (figure 7-13 or 7-14).

(3) Fuel flow and manifold pressure — From the Manifold Pressure Available for Takeoff Chart (figure 7-10).

2. Aircraft Performance.

(1) Takeoff distances — Ground roll and obstacle height distances from the Takeoff-Normal Chart (figure 7-11 or 7-12).

(2) Acceleration check — Speed corresponding to distance from the Acceleration Check Distance Chart (figure 7-15 or 7-16).

(3) Emergency — Single-engine rates of climb from Single-Engine Climb Chart (figure 7-19 or 7-20).

(3) Complete departure planning by insuring the following conditions are satisfied.

1. Crosswind conditions are within the recommended area on the Crosswind-Takeoff or Landing Chart (figure 7-7 or 7-8).

2. Takeoff distances required are less than distances available.

3. Single-engine rate-of-climb with gear down is positive.

4. Obstacles can be cleared in the event of engine failure.

b. Climb.

NOTE

Rate-of-climb determined here is valid only for the pressure altitude and temperature used. A change in pressure altitude and/or temperature will necessitate re-evaluation at the new atmospheric conditions.

(1) Determine the following before entering performance charts.

1. Atmospheric conditions.

PERFORMANCE PLANNING
(NORMAL TWO ENGINE PROCEDURES)

DEPARTURE

PRESS. ALT _____ FT FAT _____ °C
WIND: DIRECTION _____ SPEED _____ KT
RUNWAY: DIRECTION ____ LENGTH ____ SLOPE _____ % UP DN
OBSTACLES: HEIGHT ____ FT DISTANCE _____ FT
TAKEOFF WEIGHT _____ LB
AIRSPEEDS (IAS): Vmc _____ KT
ROTATION _____ KT
TAKEOFF _____ KT
OBSTACLE CLEARANCE _____ KT
FUEL FLOW _____ GAL/HR/ENG MAN PRESS _____ IN HG
TAKEOFF DISTANCES: GROUND ROLL DISTANCE _____ FT
OBSTACLE CLEARANCE DISTANCE _____ FT
ACCELERATION CHECK: DISTANCE _____ FT SPEED ____ KT

CLIMB

PRESS ALT _____ FT FAT _____ °C
WEIGHT _____ LB
CLIMB IAS _____ KT MAX R/C IAS _____ KT
MAX HP AVAILABLE _____ HP/ENG
LEVEL FLIGHT HP REQUIRED _____ HP/ENG
CLIMB HP AVAILABLE _____ HP/ENG
ENG SPEED _____ RPM MAN PRESS _____ IN HG
FUEL FLOW _____ GAL/HR/ENG LB/HR/ENG _____ LB/HR
R/C _____ FT/MIN

CRUISE

PRESS ALT _____ FT FAT _____ °C
WEIGHT _____ LB
TAS _____ KT IAS _____ KT
LEVEL FLIGHT HP _____ HP/ENG _____ HP
ENG SPEED _____ RPM MAN PRESS _____ IN HG
FUEL FLOW _____ GAL/HR/ENG LB/HR/ENG _____ LB/HR

ARRIVAL

PRESS ALT _____ FT FAT _____ °C
WIND: DIRECTION _____ SPEED _____ KT
RUNWAY: DIRECTION ____ LENGTH ____ FT. SLOPE ____ % UP DN
WEIGHT _____ LB APPROACH IAS _____ KT
LANDING GROUND DISTANCE _____ FT

PREFORMANCE PLANNING
(EMERGENCY SINGLE-ENGINE PROCEDURES)

DEPARTURE

R/C GEAR DOWN _____ FT/MIN R/C GEAR UP _____ FT/MIN
CLIMB IAS _____ KT (OBSTACLE CLEARANCE IAS)

CLIMB

PRESS ALT _____ FT FAT _____ °C
WEIGHT _____ LB
CLIMB IAS _____ KT MAX R/C IAS _____ KT
MAX HP AVAILABLE _____ HP/ENG
LEVEL FLIGHT HP REQUIRED _____ HP/ENG
CLIMB HP AVAILABLE _____ HP/ENG
ENG SPEED _____ RPM MAN PRESS _____ IN HG
FUEL FLOW _____ GAL/HR/ENG LB/HR/ENG
R/C _____ FT/MIN

CRUISE

PRESS ALT _____ FT FAT _____ °C
WEIGHT _____ LB
TAS _____ KT IAS _____ KT
LEVEL FLIGHT HP _____ HP/ENG
ENG SPEED _____ RPM MAN PRESS _____ IN HG
FUEL FLOW _____ GAL/HR/ENG LB/HR/ENG _____ LB/HR

GLIDE

HEIGHT ABOVE TERRAIN _____ FT WEIGHT _____ LB
GLIDE IAS _____ KT
GLIDE DISTANCE _____ NM

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Figure 7-1. Performance Planning Card

(1) Pressure altitude.

(2) FAT.

2. Aircraft Conditions.

(1) Weight — Estimated from fuel flow and elapsed time. Refer to Fuel Flow Chart (figure 7-9) to obtain LB/HR conversion.

(2) Climb IAS — Desired climb speed if other than for maximum performance.

(2) Determine the following from the appropriate Cruise Charts (figure 7-25 thru 7-46). Use the two engine or single-engine graphs as required. (Interpolation between charts may be necessary.)

1. Max. R/C IAS.

2. Max. HP available.

3. Level Flight HP — At climb IAS or max R/C IAS, whichever is to be used for climb.

4. Climb HP available — Max HP available less level flight HP required.

5. Engine speed.

6. Climb fuel flow — At Max HP available (Gal/Hr).

(3) Determine the following from the performance charts indicated:

1. Fuel flow in LB/HR/ENG — From Fuel Flow Chart (figure 7-9). (For two engine operation, double the fuel flow per engine to obtain total fuel flow.)

2. Rate-of-Climb — From Climb/Descent Chart (Figure 7-47 or 7-48); horsepower change is the climb HP available determined above. (Use two engine or single-engine operation as necessary.)

c. Cruise Climb.

(1) Determine the following before entering the Cruise Climb Chart (figure 7-23 or 7-24):

1. Pressure altitude — Initial and final.

2. FAT — Initial and final corresponding to initial and final pressure altitudes.

3. Aircraft weight at beginning of cruise climb.

(2) Enter the Cruise Chart and determine:

1. Time — Difference between times for final and initial conditions.

2. Fuel — Difference between fuel required for final and initial conditions.

3. Distance — Difference between distance required for final and initial conditions.

d. Cruise.

(1) Determine the following before entering performance charts:

1. Atmospheric conditions for cruise.

(1) Pressure altitude.

(2) FAT.

2. Aircraft Conditions.

(1) Weight — Estimated average cruise weight (consider distance and estimated speed and fuel flow rate).

(2) Cruise airspeeds — If other than for maximum performance.

(2) Determine the following from the appropriate Cruise Charts (figure 7-25 thru 7-46). Use Two Engine or Single-Engine Charts as required. (Interpolation between charts may be necessary.)

1. Maximum performance airspeeds — If max performance is desired.

2. Level flight HP required — At the desired airspeed.

3. Engine speed.

4. Manifold pressure.

5. Cruise fuel flow — Refer to Fuel Flow Chart (figure 7-9) to obtain LB/HR and GAL/HR.

e. Arrival.

(1) Determine the following before entering performance charts:

TEMPERATURE/CONVERSION CORRECTION

GREEN

EXAMPLE II-1

WANTED

TRUE FAT

KNOWN

INDICATED FAT = 2.5°C
TRUE AIRSPEED = 154 KT

METHOD

ENTER INDICATED FAT HERE
MOVE RIGHT TO TRUE AIRSPEED MOVE DOWN TO READ TRUE FAT = 0.5°C

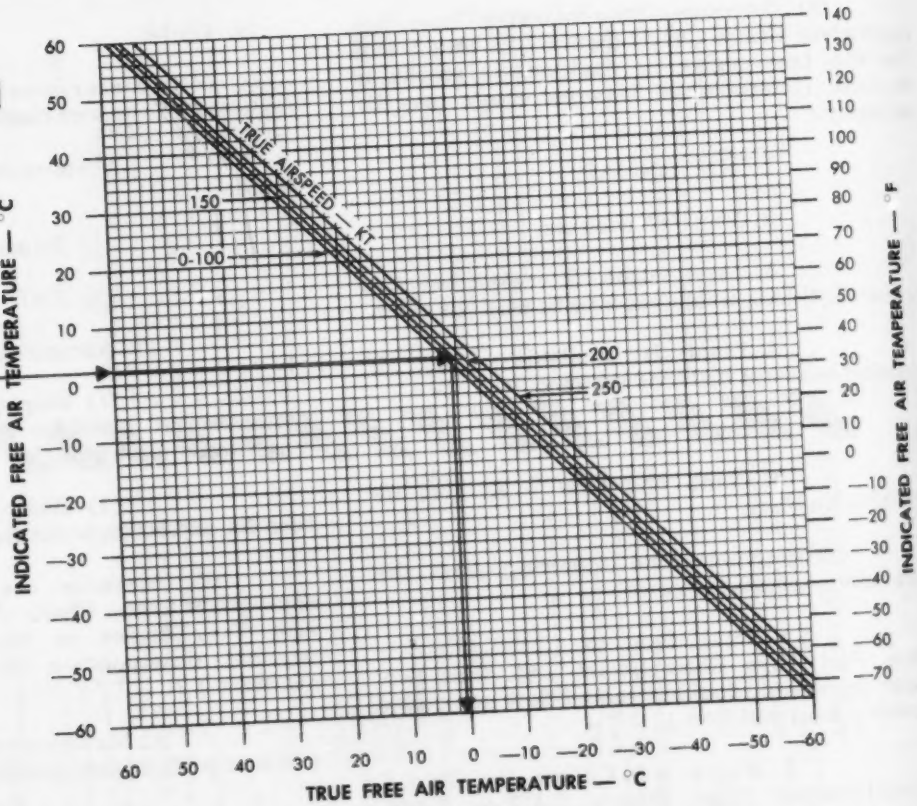

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Figure 7-2. Temperature Conversion/Correction

1. Atmospheric conditions at destination.

(1) Pressure altitude.

(2) FAT.

(3) Wind (direction/speed).

2. Airport conditions.

(1) Runway (direction/length/slope).

(2) Obstacles.

3. Aircraft conditions.

(1) Landing weight — Estimated (consider total fuel used for flight).

(2) Flap setting to be used for landing.

(2) Enter performance charts and determine:

1. Approach IAS — From Approach Speed Chart (figure 7-49 or 7-50).

2. Landing ground roll distance — From Landing Chart (figure 7-51 or 7-52).

(3) Complete arrival planning by insuring the following conditions are satisfied:

1. Crosswind conditions are within the recommended area on the Crosswind-Takeoff or Landing Chart (figure 7-7 or 7-8).

2. The landing distance required is less than distance available.

f. Glide.

(1) Determine the following before entering performance chart:

1. Height above terrain.

2. Aircraft weight — Estimated.

(2) Enter the Glide Distance Chart (figure 9-3 or 9-4) and determine:

1. Glide IAS — From table corresponding to estimated weight.

2. Glide distance.

7-17. Performance Information.

Performance information obtained may make it necessary to alter gross weight, airspeed, altitude, or other variables in order to safely operate the aircraft. If any of these variables are changed on one chart, corresponding changes will be necessary on all other charts where that information is used.

7-18. Airspeed Position Error Correction.

The relationship between indicated airspeed and calibrated airspeed for various flap settings is shown for the static air source (figure 7-3 or 7-4).

NOTE

Indicated airspeed assumes a zero instrument error, also, no significant change in airspeed position correction is apparent due to power settings, altitude or landing gear position. All airspeed calibrations were conducted in level flight and may not be appropriate for stall.

7-19. Altimeter Position Error Correction.

The altitude corrections to be made to the altimeter reading are shown for various altitudes and flap positions for the static air source (figure 7-5 or 7-6).

NOTE

Indicated altitude assumes a zero instrument error, also, no significant change in position error correction is apparent due to power settings or landing gear position.

GREEN

AIRSPEED CALIBRATION

AIRSPEED CALIBRATION
U-8D, U-8G
O-480-1

EXAMPLE II-2

WANTED

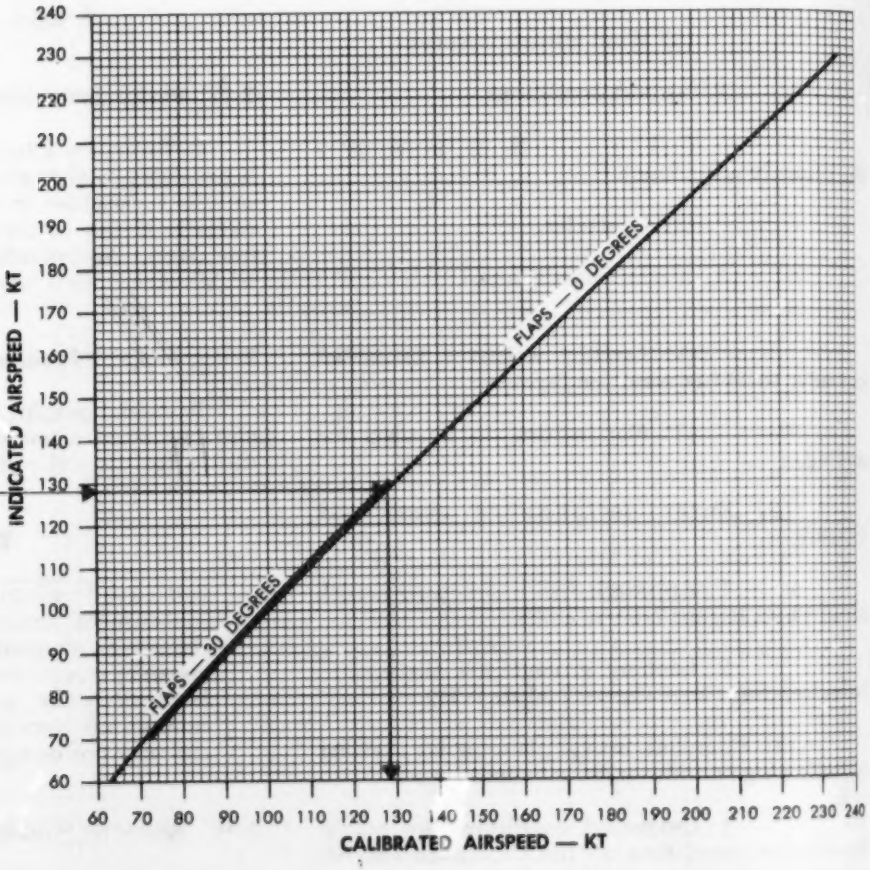
CALIBRATED AIRSPEED

KNOWN

INDICATED AIRSPEED = 128 KT
FLAP SETTING = 0 DEGREES

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN, READ CALIBRATED AIRSPEED = 128 KT



AP 001886

Figure 7-3. Airspeed Calibration (U-8D, U-8G)

GREEN

AIRSPEED CALIBRATION

AIRSPEED CALIBRATION
RU-8D
O-480-1

EXAMPLE II-3

WANTED

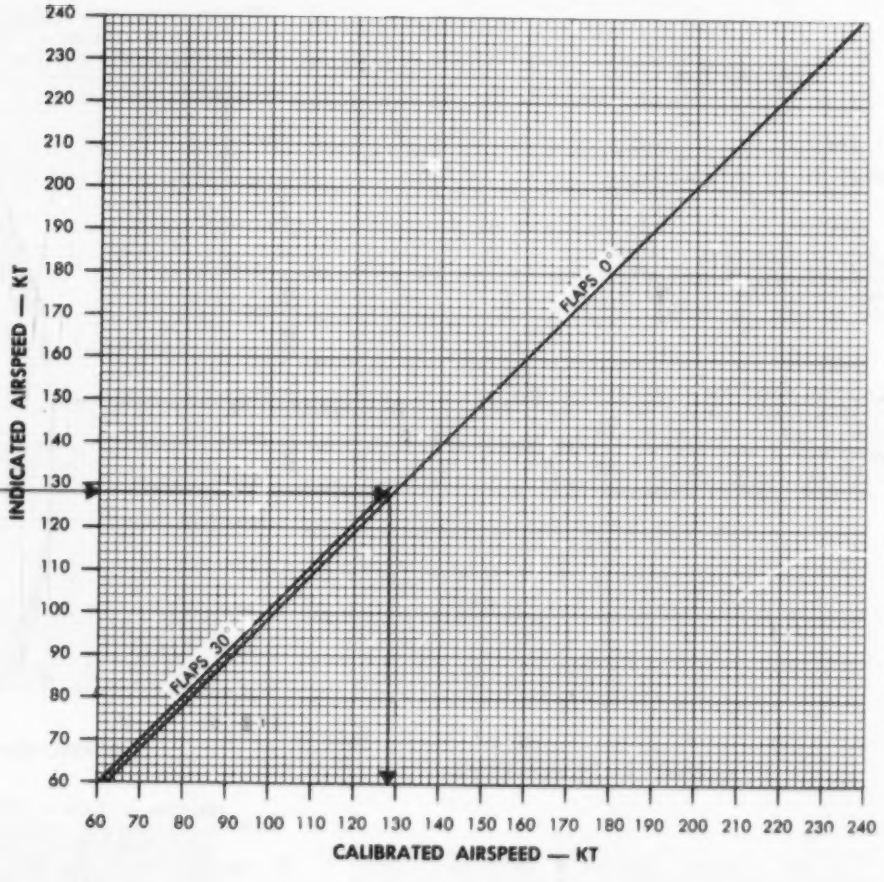
CALIBRATED AIRSPEED

KNOWN

INDICATED AIRSPEED = 128 KT
FLAP SETTING = 0°

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN, READ CALIBRATED AIRSPEED = 128 KT



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 002067

Figure 7-4. Airspeed Calibration (RU-8D)

ALTIMETER CORRECTION

GREEN

ALTIMETER CORRECTION
U-8D, U-8G
O-480-1

EXAMPLE II-4

WANTED

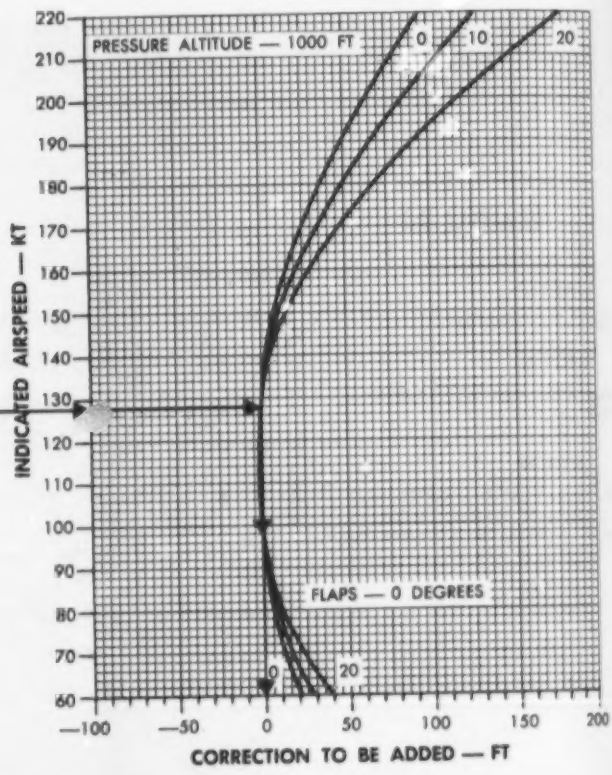
CORRECTED ALTITUDE

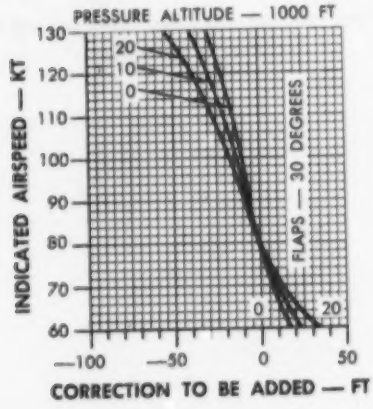
KNOWN

INDICATED ALTITUDE = 12,000 FT
INDICATED AIRSPEED = 128 KT
PRESSURE ALTITUDE = 12,000 FT
FLAP SETTING = 0 DEGREES

METHOD

MOVE TO CHART FOR PROPER FLAP SETTING
ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN, READ ALTITUDE CORRECTION = 0 FT
CORRECTED ALTITUDE = (INDICATED ALTITUDE + CORRECTION) = 12,000 FT





AP 001887

DATA BASIS: DERIVED FROM FLIGHT TEST

Figure 7-5. Altimeter Correction (U-8D, U-8G)

GREEN

ALTIMETER CORRECTION

ALTIMETER CORRECTION
RU-8D
O-480-1

EXAMPLE II-5

WANTED

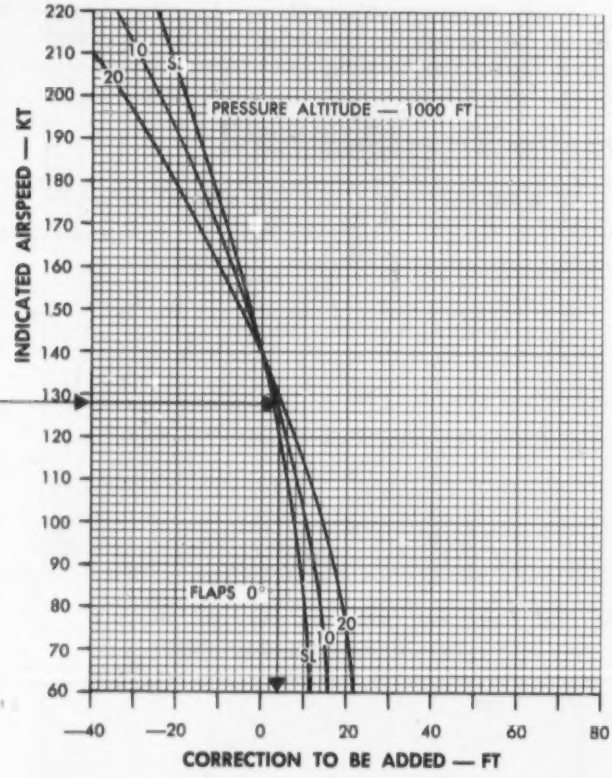
CORRECTED ALTITUDE

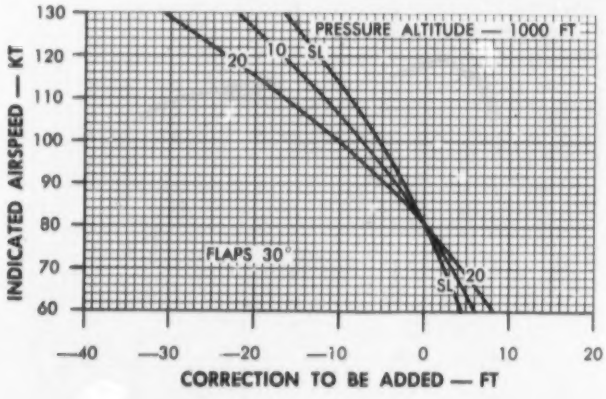
KNOWN

INDICATED ALTITUDE = 12,000 FT
INDICATED AIRSPEED = 128 KT
PRESSURE ALTITUDE = 12,000 FT
FLAP SETTING = 0°

METHOD

MOVE TO CHART FOR PROPER FLAP SETTING
ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN, READ ALTITUDE CORRECTION = 4 FT
CORRECTED ALTITUDE = (INDICATED ALTITUDE + CORRECTION) = 12,004 FT





DATA BASIS: DERIVED FROM FLIGHT TEST

AP 002062

Figure 7-6. Altimeter Correction (RU-8D)

Section III. CROSSWIND – TAKEOFF OR LANDING

7-20. Description. U-8D U-8G

The Crosswind-Takeoff or Landing Chart (figure 7-7) shows the crosswind conditions under which a takeoff or landing is not recommended.

7-21. Use of Chart. U-8D U-8G

The primary use of the Crosswind-Takeoff or Landing Chart is shown in Example III- Recommended rotation airspeed is obtained fro the Normal Rotation/Takeoff Airspeed Cha (figure 7-13). Takeoff should not be attempte when the rotation speed intercept point fal within the non-recommended area. Select touchdown airspeed less than the approac airspeed obtained from the Approach Speed Cha (figure 7-49) such that the touchdown airspee falls within the recommended area.

GREEN

CROSSWIND — TAKEOFF OR LANDING

CROSSWIND-TAKEOFF
OR LANDING
U-8D, U-8G
O-480-1

EXAMPLE III-1

WANTED

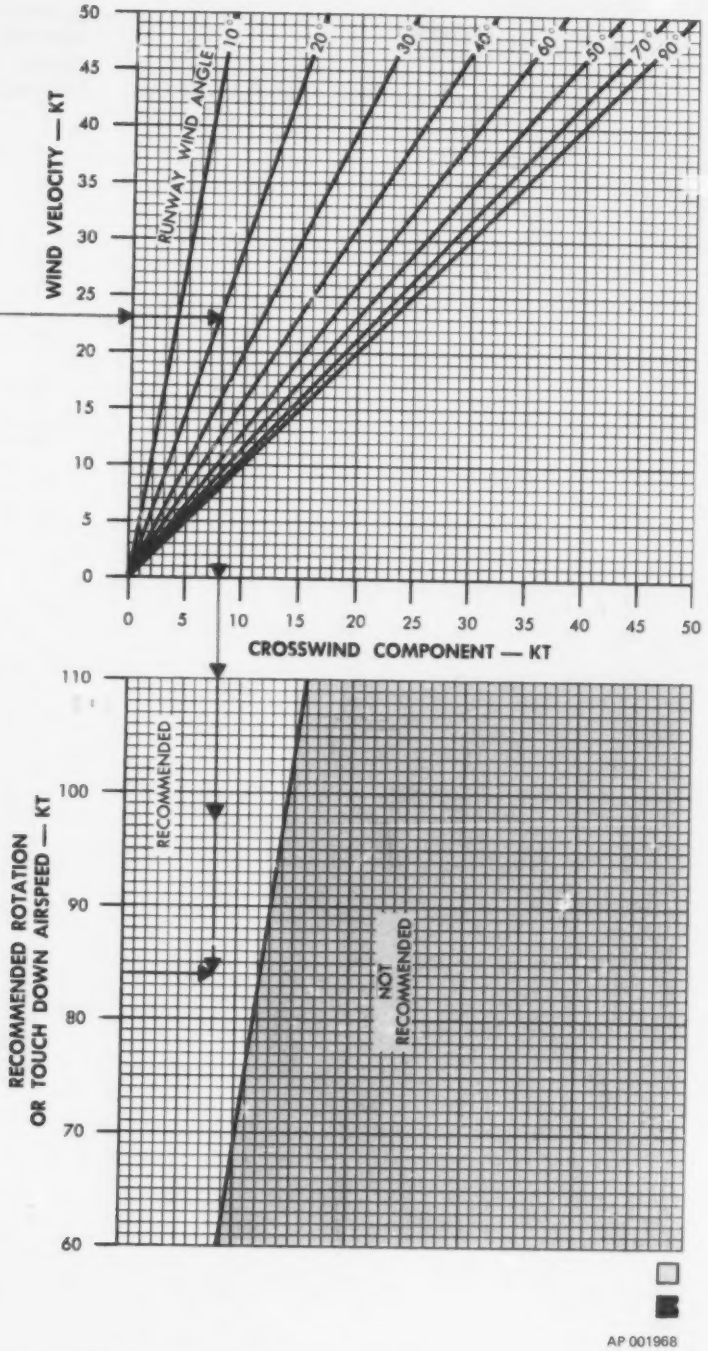
DETERMINE IF THE CROSSWIND EXCEEDS RECOMMENDED CONDITIONS FOR TAKEOFF

KNOWN

RUNWAY 21
WIND VELOCITY = 23 KT
WIND DIRECTION = 190°
NORMAL ROTATION AIRSPEED = 84 KT

METHOD

DETERMINE RUNWAY WIND ANGLE
210° − 190° = 20°
ENTER WIND VELOCITY HERE
MOVE RIGHT TO RUNWAY WIND ANGLE
MOVE DOWN TO NORMAL ROTATION AIRSPEED LINE
THE INTERSECTION POINT FALLS WITHIN THE RECOMMENDED AREA



DATA BASIS: ESTIMATED

Figure 7-7. Crosswind - Takeoff or Landing (U-8D, U-8G)

7-22. Description. RU-8D

The Crosswind-Takeoff or Landing Chart (figure 7-8) shows the crosswind conditions under which a takeoff or landing is not recommended.

7-23. Use of Chart. RU-8D

The primary use of the Crosswind-Takeoff or Landing Chart is shown in Example III-2. Recommended rotation airspeed is obtained from the Normal Rotation/Takeoff Airspeed Chart (figure 7-14). Takeoff should not be attempted when the rotation speed intercept point falls within the non-recommended area. Select a touchdown airspeed less than the approach airspeed obtain from the Approach Speed Chart (figure 7-50) such that the touchdown airspeed falls within the recommended area.

GREEN
RED

CROSSWIND — TAKEOFF OR LANDING

CROSSWIND-TAKEOFF
OR LANDING
RU-8D
O-480-1

EXAMPLE III-2

WANTED

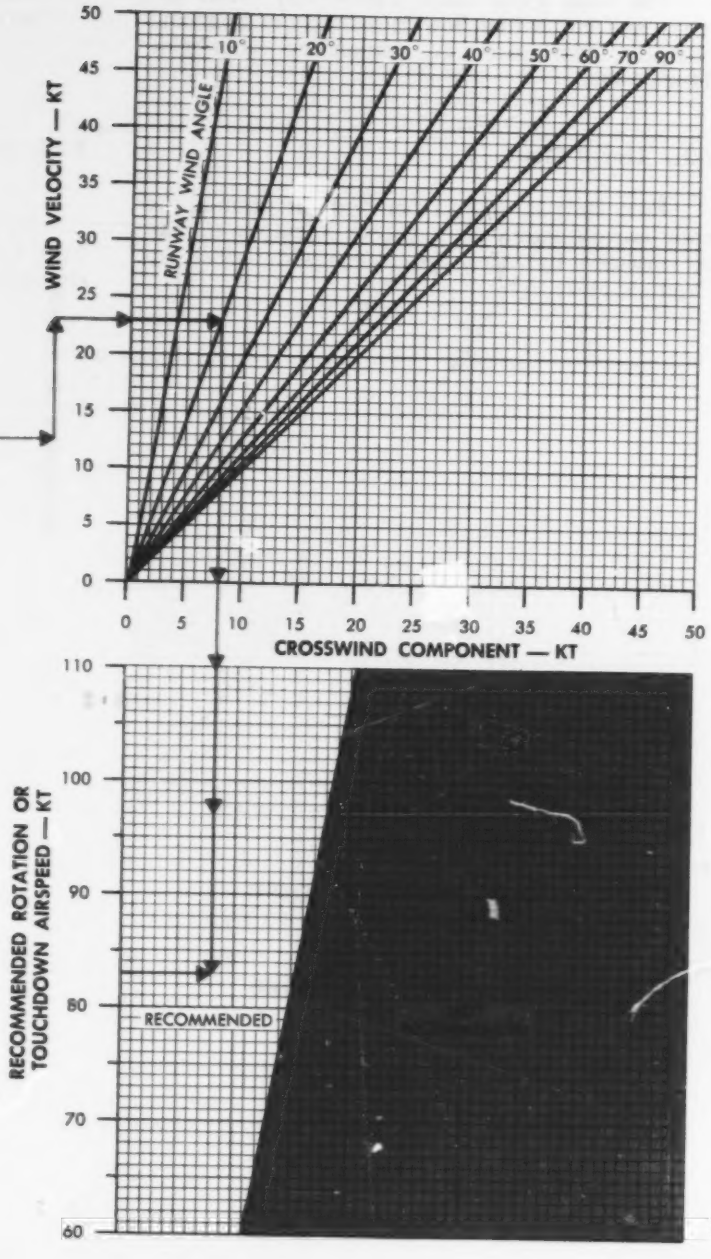
DETERMINE IF THE CROSSWIND EXCEEDS RECOMMENDED CONDITIONS FOR TAKEOFF

KNOWN

RUNWAY 21
WIND VELOCITY = 23 KT
WIND DIRECTION = 190°
NORMAL ROTATION AIRSPEED = 83 KT

METHOD

DETERMINE RUNWAY WIND ANGLE
210° − 190° = 20°
ENTER WIND VELOCITY HERE
MOVE RIGHT TO RUNWAY WIND ANGLE
MOVE DOWN TO NORMAL ROTATION AIRSPEED LINE
THE INTERSECTION POINT FALLS WITHIN THE RECOMMENDED AREA



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001997

Figure 7-8. Crosswind - Takeoff or Landing (RU-8D)

Section IV. IDLE FUEL FLOW

7-24. Description.

The Fuel Flow Chart (figure 7-9) shows the cruise and climb fuel flow in gallons per hour and pounds per hour corresponding to engine horsepower.

7-25. Use of Chart.

Fuel flow in gallons per hour or pounds per hour corresponding to a known horsepower may be obtained by using the methods described by Example IV-1.

NOTE

Fuel flow values should be doubled for two engine operation.

7-26. Conditions.

All fuel flow data is based on aviation gasoline 100/130. Variation in fuel temperature may change the fuel flow values slightly.

GREEN

FUEL FLOW

FUEL FLOW
U-8D, U-8G, RU-8D
O-480-1

EXAMPLE IV-1

WANTED

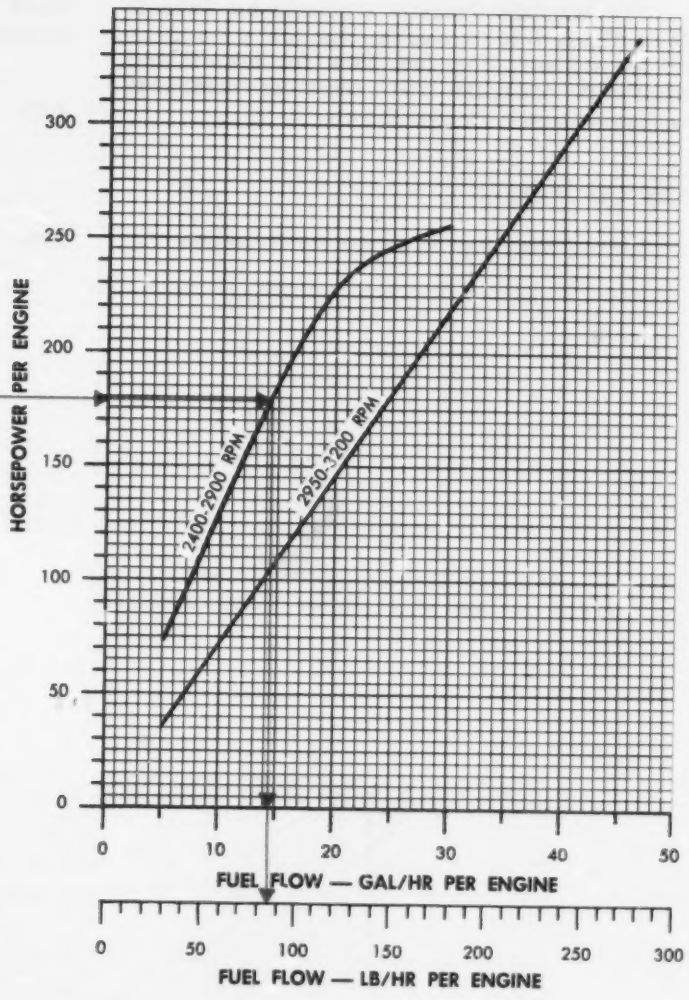
FUEL FLOW FOR A GIVEN HORSEPOWER

KNOWN

HORSEPOWER PER ENGINE = 178
ENGINE RPM = 2600

METHOD

ENTER HORSEPOWER PER ENGINE HERE
MOVE RIGHT TO ENGINE RPM
MOVE DOWN, READ FUEL FLOW
RATE = 14.4 GAL/HR (85 LB/HR)



DATA BASIS: CALCULATED

AP 001966

Figure 7-9. Fuel Flow

SECTION V. MANIFOLD PRESSURE AVAILABLE FOR TAKEOFF

7-27. Description.

The Manifold Pressure Available for Takeoff Chart (figure 7-10) shows the manifold pressure to set for takeoff. The fuel flow for takeoff and manifold pressure for climb at maximum continuous power are also shown.

7-28. Use of Chart.

Use of the chart is shown by Examples V-1 and V-2. Takeoff distances scheduled on the Takeoff-Normal Chart (figure 7-11 or 7-12) are based on engine speed and manifold pressure set according to this chart.

7-29. Conditions.

a. Throttles — Advance to takeoff power.

b. Engine speed — 3400 RPM (takeoff); 3200 RPM (maximum continuous climb).

GREEN
RED

MANIFOLD PRESSURE AVAILABLE FOR TAKEOFF

MANIFOLD PRESSURE AVAILABLE FOR TAKEOFF
U-8D, U-8G, RU-8D
O-480-1

EXAMPLE V-1

WANTED

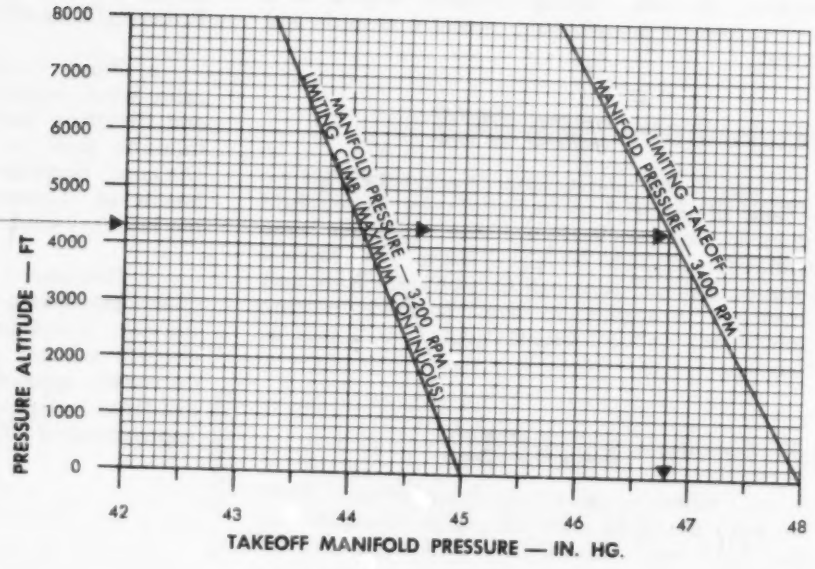
MAXIMUM MANIFOLD PRESSURE FOR TAKEOFF

KNOWN

PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO LIMITING TAKEOFF MANIFOLD PRESSURE LINE
MOVE DOWN, READ MAXIMUM MANIFOLD PRESSURE FOR TAKEOFF = 46.8 IN. HG.



EXAMPLE V-2

WANTED

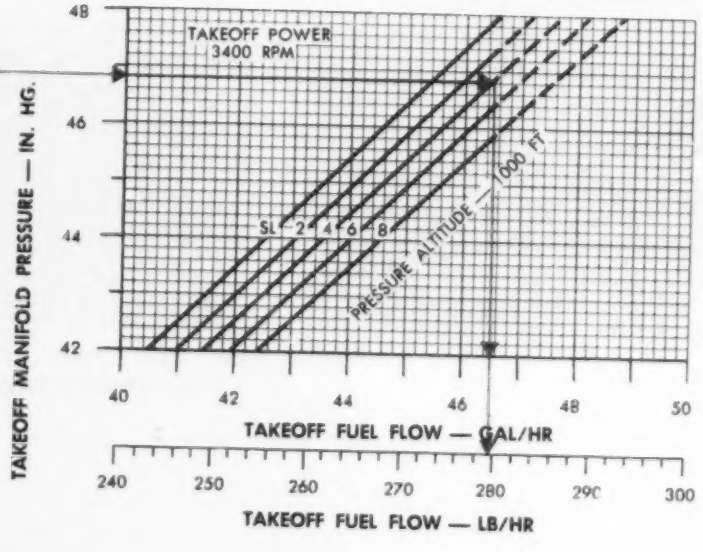
FUEL FLOW FOR TAKEOFF

KNOWN

TAKEOFF MANIFOLD PRESSURE = 46.8 IN. HG.
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER MANIFOLD PRESSURE HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN, READ FUEL FLOW FOR TAKEOFF = 46.5 GAL/HR (279 LB/HR)



DATA BASIS: CALCULATED

AP 001972

Figure 7-10. Manifold Pressure Available for Takeoff

Section VI. NORMAL TAKEOFF

7-30. Description. U-8D U-8G

The Takeoff-Normal Chart (figure 7-11) shows the ground roll distance and the total distance required to clear varying obstacle heights at a known free air temperature, pressure altitude and weight.

7-31. Use of Chart. U-8D U-8G

Takeoff ground roll distance and total distance to clear an obstacle can be found using the method shown in Example VI-1. In order to achieve these distances, airspeeds obtained from the Normal Rotation/Takeoff Airspeed Chart (figure 7-13) and power set according to the Manifold Pressure available for Takeoff Chart (figure 7-10) shall be used.

7-32. Conditions. U-8D U-8G

a. Engines – Both engines operating at 3400 RPM with manifold pressure set according to the Manifold Pressure Available for Takeoff Chart (figure 7-10).

b. Flaps — UP.

c. Landing gear — DOWN.

d. Technique — Apply takeoff power and accelerate on the runway. Initiate rotation at the speed appropriate for weight. Achieve and maintain the obstacle clearance airspeed until obstacles have been cleared. Refer to Normal Rotation/Takeoff Airspeed Chart (figure 7-13).

e. Wind — All data presented are based on calm wind conditions. Since surface wind speed and direction cannot be accurately predicted, all takeoffs shall be planned based on calm wind. Distance decreases approximately 1% per knot headwind. Distance increases approximately 3% per knot tailwind.

f. Runway — Runway conditions for this chart are based on a dry, hard-surface, level runway. Conditions other than these will vary aircraft takeoff distances. Ground roll distance decreases approximately 3% per 1% downhill gradient. Ground roll distance increases approximately 7% per 1% uphill gradient.

NOTE

Refer to the Single-Engine Climb Chart (figure 7-19) to determine if adequate performance is available in the event of engine failure during takeoff.

GREEN

TAKEOFF — NORMAL

CALM WINDS FLAPS 0 DEGREES TAKEOFF POWER - 3400 RPM

DRY, HARD, LEVEL SURFACE

TAKEOFF — NORMAL
U-8D, U-8G
O-480-1

EXAMPLE VI-1

WANTED

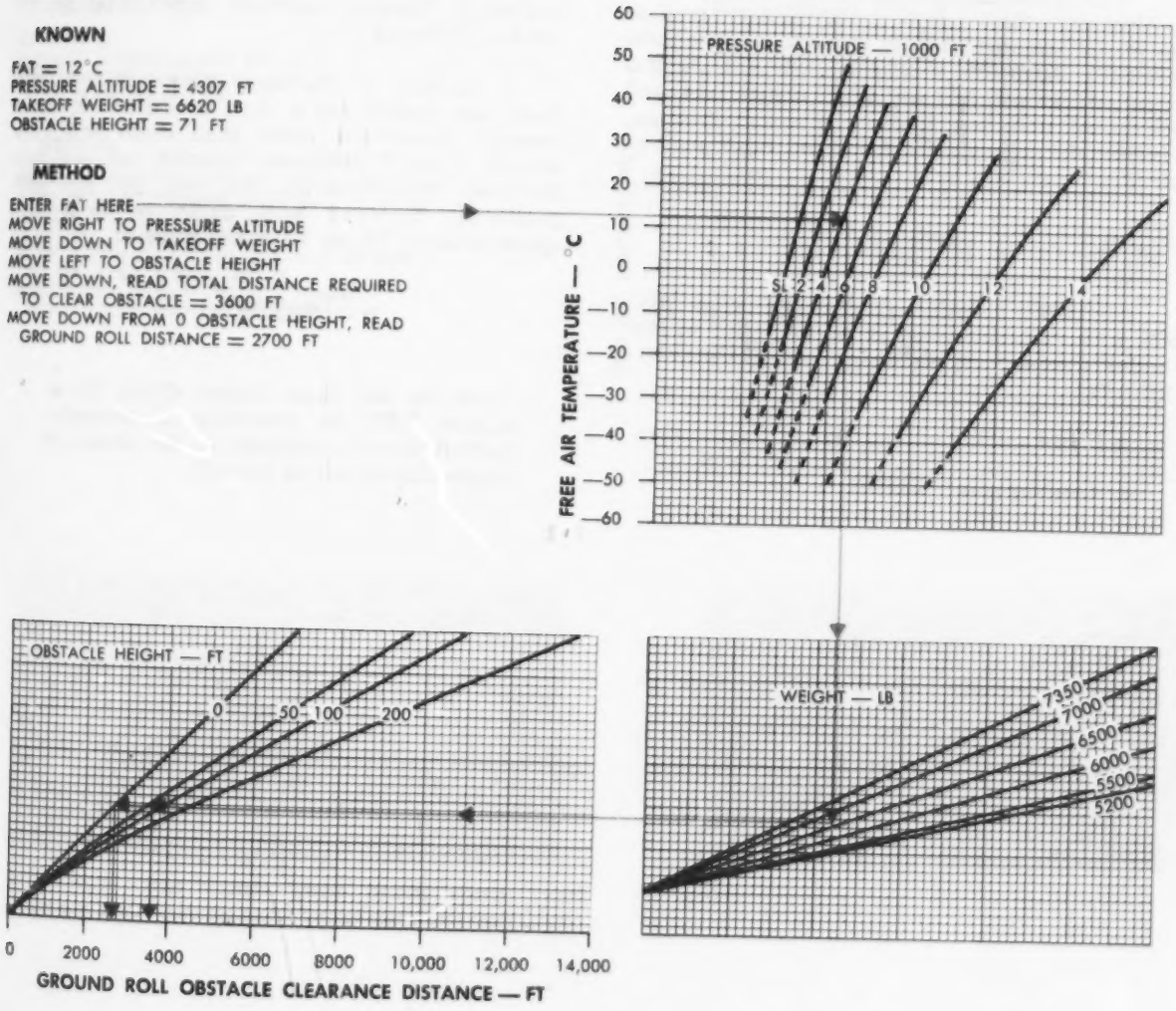
REQUIRED GROUND ROLL AND OBSTACLE CLEARANCE DISTANCE

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT
TAKEOFF WEIGHT = 6620 LB
OBSTACLE HEIGHT = 71 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO TAKEOFF WEIGHT
MOVE LEFT TO OBSTACLE HEIGHT
MOVE DOWN, READ TOTAL DISTANCE REQUIRED TO CLEAR OBSTACLE = 3600 FT
MOVE DOWN FROM 0 OBSTACLE HEIGHT, READ GROUND ROLL DISTANCE = 2700 FT



DATA BASIS: FLIGHT TEST

AP 001967

Figure 7-11. Takeoff - Normal (U-8D, U-8G)

7-33. Description. RU-8D

The Takeoff-Normal Chart (figure 7-12) shows the ground roll distance and the total distance required to clear varying obstacle heights at a known free air temperature, pressure altitude and weight.

7-34. Use of Chart. RU-8D

Takeoff ground roll distance and total distance to clear an obstacle can be found using the method shown in Example VI-2. In order to achieve these distances, airspeeds obtained from the Normal Rotation/Takeoff Airspeed Chart (figure 7-14) and power set acording to the Manifold Pressure available for Takeoff Chart (figure 7-10) shall be used.

7-35. Conditions. RU-8D

a. Engines — Both engines operating at 3400 RPM with manifold pressure set according to the Manifold Pressure Available for Takeoff Chart (figure 7-10).

b. Flaps — UP.

c. Landing gear — DOWN.

d. Technique — Apply takeoff power and accelerate on the runway. Initiate rotation at the speed appropriate for weight. Achieve and maintain the obstacle clearance airspeed until obstacles have been cleared. Refer to Normal Rotation/Takeoff Airspeed Chart (figure 7-14).

e. Wind — All data presented are based on calm wind conditions. Since surface wind speed and direction cannot be accurately predicted, all takeoffs shall be planned based on calm wind. Distance decreases approximately 1% per knot headwind. Distance increases approximately 3% per knot tailwind.

f. Runway — Runway conditions for this chart are based on a dry, hard-surface, level runway. Conditions other than these will vary aircraft takeoff distances. Ground roll distance decreases approximately 3% per 1% downhill gradient. Ground roll distance increases approximately 7% per 1% uphill gradient.

NOTE

Refer to the Single-Engine Climb Chart (figure 7-20) to determine if adequate performance is available in the event of engine failure during takeoff.

GREEN

TAKEOFF — NORMAL
CALM WINDS FLAPS 0 DEGREES
TAKEOFF POWER-3400 RPM
DRY, HARD, LEVEL SURFACE

TAKEOFF — NORMAL
RU-8D
O-480-1

EXAMPLE VI-2

WANTED

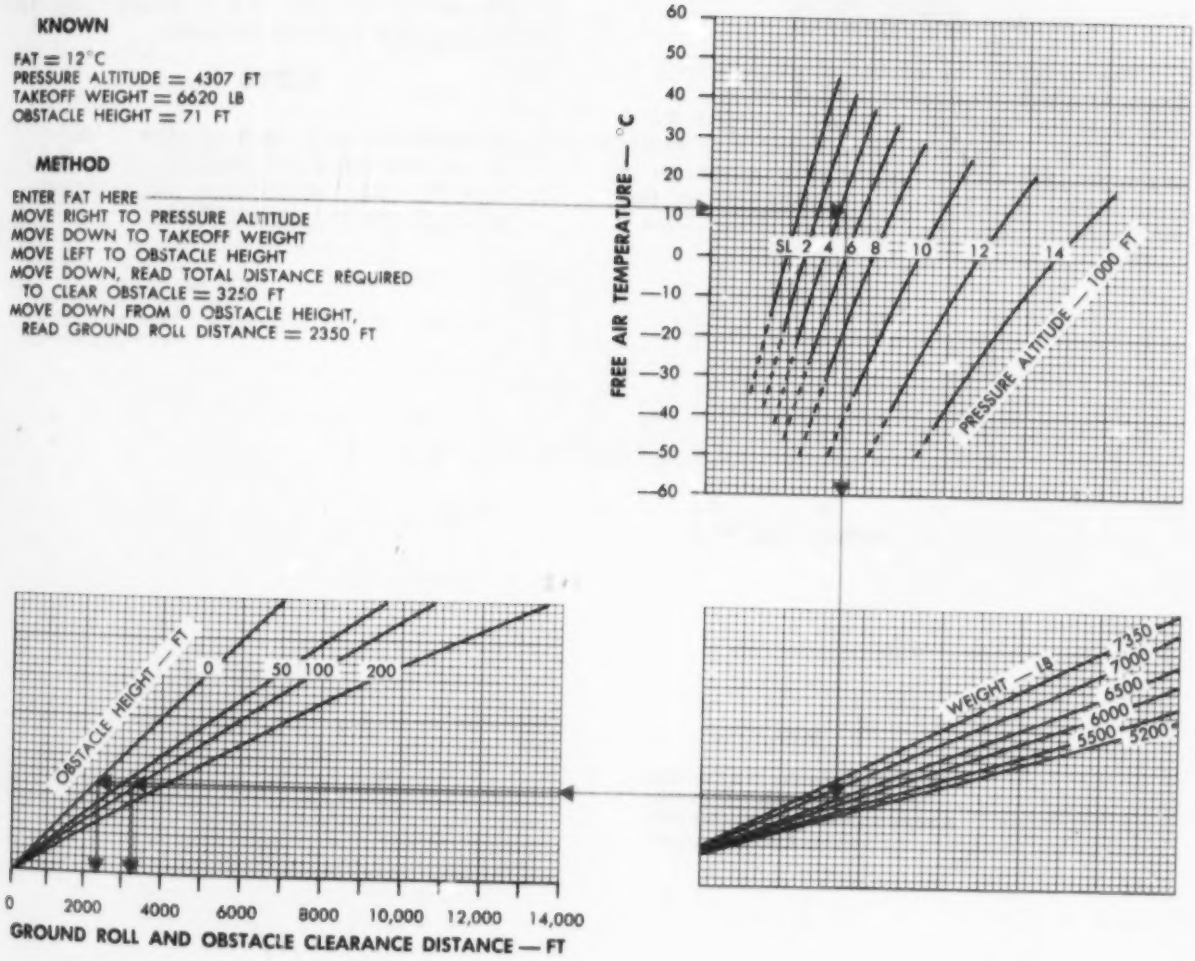
REQUIRED GROUND ROLL AND OBSTACLE CLEARANCE DISTANCE

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT
TAKEOFF WEIGHT = 6620 LB
OBSTACLE HEIGHT = 71 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO TAKEOFF WEIGHT
MOVE LEFT TO OBSTACLE HEIGHT
MOVE DOWN, READ TOTAL DISTANCE REQUIRED TO CLEAR OBSTACLE = 3250 FT
MOVE DOWN FROM 0 OBSTACLE HEIGHT, READ GROUND ROLL DISTANCE = 2350 FT



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 002061

Figure 7-12. Takeoff - Normal (RU-8D)

Section VII. NORMAL ROTATION/TAKEOFF AIRSPEED

7-36. Description. U-8D U-8G

The Normal Rotation/Takeoff Airspeed Chart (figure 7-13) shows rotation, takeoff, and obstacle clearance airspeeds for a known weight.

7-37. Use of Chart. U-8D U-8G

The primary use of the chart is shown in Example VII-1. The rotation airspeed line shows recommended rotation indicated airspeed for a given weight. The takeoff airspeed line shows recommended takeoff indicated airspeed for a given weight. The obstacle clearance airspeed line shows the recommended indicated airspeed for a given weight to use for clearance of obstacles during the takeoff climb. Performance scheduled on the Takeoff-Normal Chart (figure 7-11) is based on use of these speeds.

7-38. Conditions. U-8D U-8G

Flaps up is the only condition for Normal/Rotation Takeoff Airspeed.

NOTE

These speeds have been selected in order to provide adequate margins above the flaps up stall speed and single-engine minimum control airspeed (Vmc).

GREEN

NORMAL ROTATION/TAKEOFF AIRSPEED
FLAPS 0 DEGREES

NORMAL ROTATION
TAKEOFF AIRSPEED
U-8D, U-8G
O-480-1

EXAMPLE VII-1

WANTED

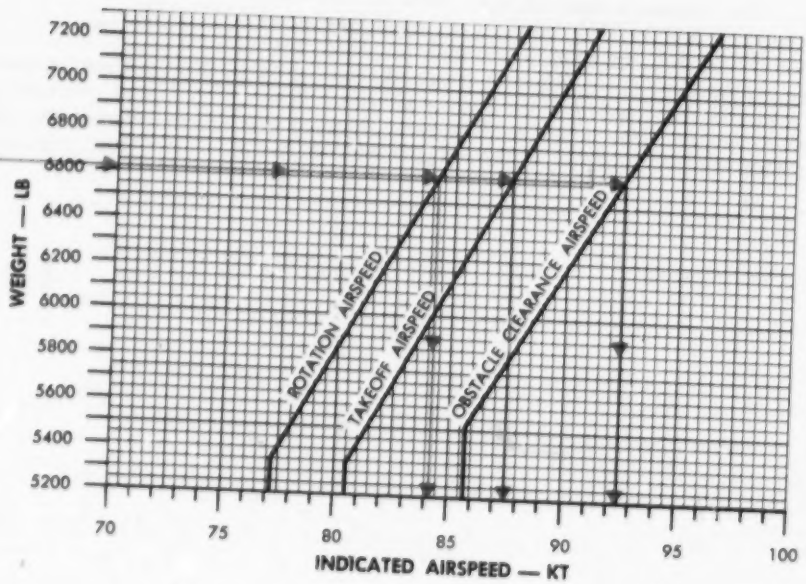
NORMAL ROTATION AND TAKEOFF AIRSPEEDS FOR KNOWN WEIGHT

KNOWN

WEIGHT = 6620 LB

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO AIRSPEED LINES
MOVE DOWN FROM ROTATION AIRSPEED LINE, READ INDICATED AIRSPEED FOR ROTATION = 84 KT
MOVE DOWN FROM TAKEOFF AIRSPEED LINE, READ INDICATED AIRSPEED FOR TAKEOFF = 88 KT
MOVE DOWN FROM OBSTACLE CLEARANCE AIRSPEED LINE, READ INDICATED AIRSPEED FOR OBSTACLE CLEARANCE = 92 KT



NOTE

OBSTACLE CLEARANCE AIRSPEED LINE ALSO INDICATES THE BEST TWO ENGINES AND SINGLE ENGINE ANGLE OF CLIMB SPEED.

DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001962

Figure 7-13. Normal Rotation/Takeoff Airspeed (U-8D, U-8G)

7-39. Description. RU-8D

The Normal Rotation/Takeoff Airspeed Chart (figure 7-14) shows rotation, takeoff, and obstacle clearance airspeeds for a known weight.

7-40. Use of Chart. RU-8D

The primary use of the chart is shown in Example VII-2. The rotation airspeed line shows recommended rotation indicated airspeed for a given weight. The takeoff airspeed line shows recommended takeoff indicated airspeed for a given weight. The obstacle clearance airspeed line shows the recommended indicated airspeed for a given weight to use for clearance of obstacles during the takeoff climb. Performance scheduled on the Takeoff-Normal Chart (figure 7-12) is based on use of these speeds.

7-41. Conditions. RU-8D

Flaps up is the only condition for Normal Rotation/Takeoff Airspeed.

NOTE

These speeds have been selected in order to provide adequate margins above the flaps up stall speed and single-engine minimum control airspeed (Vmc).

GREEN

NORMAL ROTATION/TAKEOFF AIRSPEED

NORMAL ROTATION/
TAKEOFF AIRSPEED
RU-8D
O-480-1

EXAMPLE VII-2

WANTED

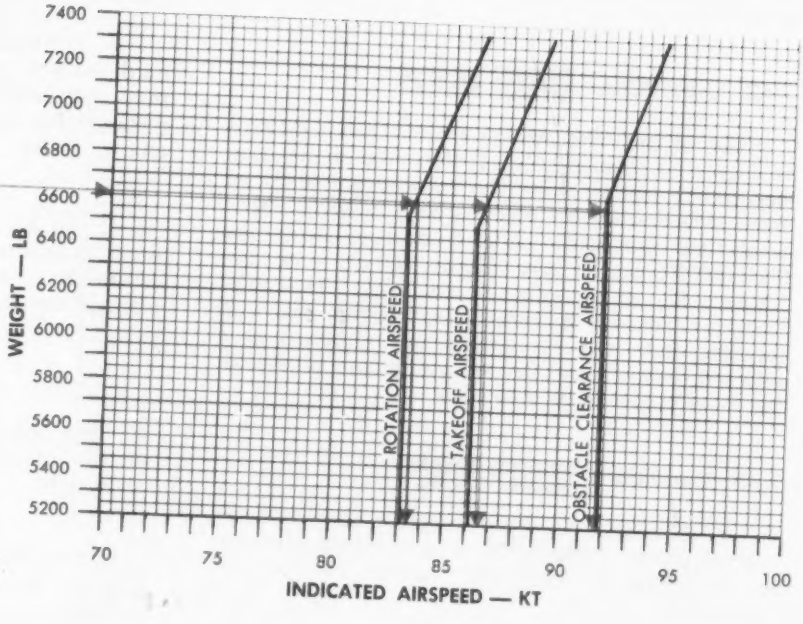
NORMAL ROTATION AND TAKEOFF AIRSPEEDS FOR KNOWN WEIGHT

KNOWN

WEIGHT = 6620 LB

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO AIRSPEED LINES
MOVE DOWN FROM ROTATION AIRSPEED LINE, READ INDICATED AIRSPEED FOR ROTATION = 83 KT
MOVE DOWN FROM TAKEOFF AIRSPEED LINE, READ INDICATED AIRSPEED FOR TAKEOFF = 87 KT
MOVE DOWN FROM OBSTACLE CLEARANCE AIRSPEED LINE, READ INDICATED AIRSPEED FOR OBSTACLE CLEARANCE = 92 KT



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001994

Figure 7-14. Normal Rotation/Takeoff Airspeed (RU-8D)

Section VIII. ACCELERATION CHECK DISTANCE

7-42. Description. U-8D U-8G

The Acceleration Check Distance Chart (figure 7-15) shows the relationship between indicated airspeed and ground roll distance during the takeoff run.

7-43. Use of Chart. U-8D U-8G

Use of the Acceleration Check Distance Chart is shown by Example VIII-1. Required airspeeds at designated points along the runway are obtained from this chart. This chart is used in conjunction with the ground roll distance from the Takeoff-Normal Chart (figure 7-11), and the tkaeoff airspeed from the Normal Rotation/Takeoff Airspeed Chart (figure 7-13). If required indicated airspeed is not obtained at a selected distance and the runway length is critical, the takeoff should be aborted.

7-44. Conditions. U-8D U-8G

a. Engines – Both engines operating at takeoff power, 3400 RPM with manifold pressure set according to Manifold Pressure for Takeoff Chart (figure 7-10).

b. Flaps — UP.

c. Landing gear — DOWN.

d. Technique — Apply takeoff power and accelerate on the runway. When the aircraft passes an acceleration check point, insure that the required airspeed has been achieved.

e. Runway — This chart is based on a dry, hard surface runway. Conditions other than this may vary aircraft operation. Adjust ground roll distance for runway gradient before entering this chart. Refer to Takeoff-Normal Chart (figure 7-11).

f. Wind — All data presented is based on calm wind conditions. Since surface wind conditions cannot be accurately predicted, all takeoffs shall be planned based on calm wind.

NOTE

This chart should always be entered with the takeoff airspeed appropriate to the weight.

g. Acceleration Check Distance — Is the distance from start of takeoff ground roll to an acceleration check point (runway distance marker, etc.).

GREEN

ACCELERATION CHECK DISTANCE
CALM WINDS FLAPS 0 DEGREES POWER-TAKEOFF-3400 RPM
DRY, HARD SURFACE

ACCELERATION CHECK DISTANCE
U-8D, U-8G
O-480-1

EXAMPLE VIII-1

WANTED

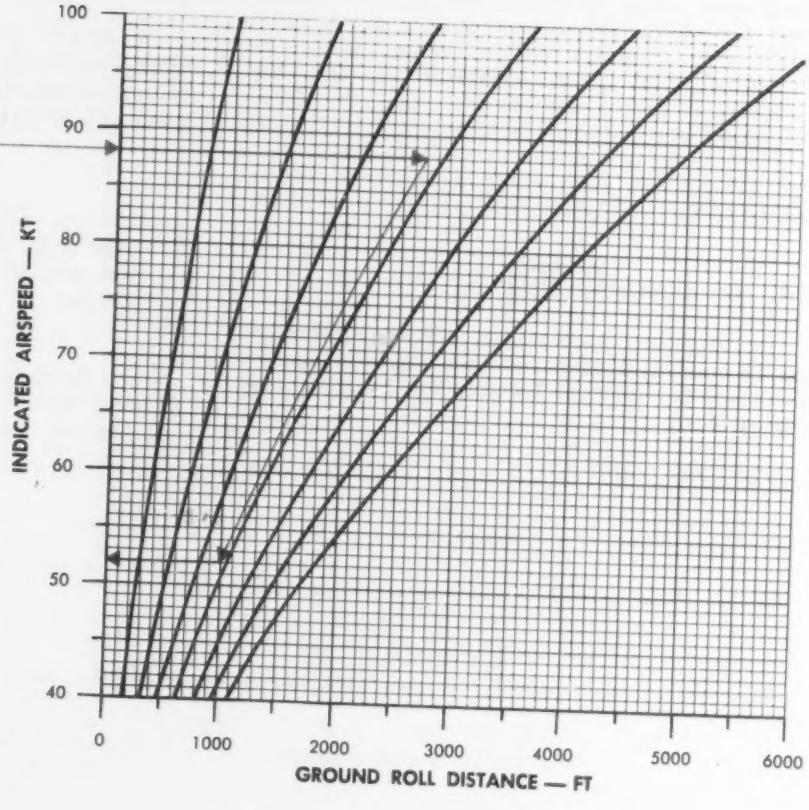
AIRSPEED REQUIRED AT VARIOUS ACCELERATION CHECK POINTS

KNOWN

TAKEOFF AIRSPEED FOR A TAKEOFF WEIGHT OF 6620 LB = 88 KT
GROUND ROLL DISTANCE = 2700 FT

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO GROUND ROLL DISTANCE LINE
MOVE DOWN PARALLELING THE GUIDELINE TO THE 1000 FT GROUND ROLL DISTANCE LINE
MOVE LEFT, READ INDICATED AIRSPEED REQUIRED AT 1000 FT MARKER = 52 KT



DATA BASIS: ESTIMATED

AP 001961

Figure 7-15. Acceleration Check Distance (U-8D, U-8G)

7-45. Description. RU - 8D

The Acceleration Check Distance Chart (figure 7-16) shows the relationship between indicated airspeed and ground roll distance during the takeoff run.

7-46. Use of Chart. RU - 8D

Use of the Acceleration Check Distance Chart is shown by Example VIII-2. Required airspeeds at designated points along the runway are obtained from this chart. This chart is used in conjunction with the ground roll distance from the Takeoff-Normal Chart (figure 7-12), and the takeoff airspeed from the Normal Rotation/Takeoff Airspeed Chart (figure 7-14). If required indicated airspeed is not obtained at a selected distance and the runway length is critical, the takeoff should be aborted.

7-47. Conditions. RU - 8D

a. Engines — Both engines operating at takeoff power and 3400 RPM with manifold pressure set according to Manifold Pressure for Takeoff Chart (figure 7-10).

b. Flaps — UP.

c. Landing gear — DOWN.

d. Technique — Apply takeoff power and accelerate on the runway. When the aircraft passes an acceleration check point, insure that the required airspeed has been achieved.

e. Runway — This chart is based on a dry, hard surface runway. Conditions other than this may vary aircraft operation. Adjust ground roll distance for runway gradient before entering this chart. Refer to Takeoff-Normal Chart (figure 7-12).

f. Wind — All data presented is based on calm wind conditions. Since surface wind conditions cannot be accurately predicted, all takeoffs shall be planned based on calm wind.

NOTE

This chart should always be entered with the takeoff airspeed appropriate to the weight.

g. Acceleration Check Distance — Is the distance from start of takeoff ground roll to an acceleration check point (runway distance marker, etc.).

GREEN

ACCELERATION CHECK DISTANCE
CALM WINDS FLAPS 0 DEGREES
POWER-TAKEOFF-3400 RPM
DRY, HARD, LEVEL SURFACE

ACCELERATION CHECK DISTANCE
RU-8D
O-480-1

EXAMPLE VIII-2

WANTED

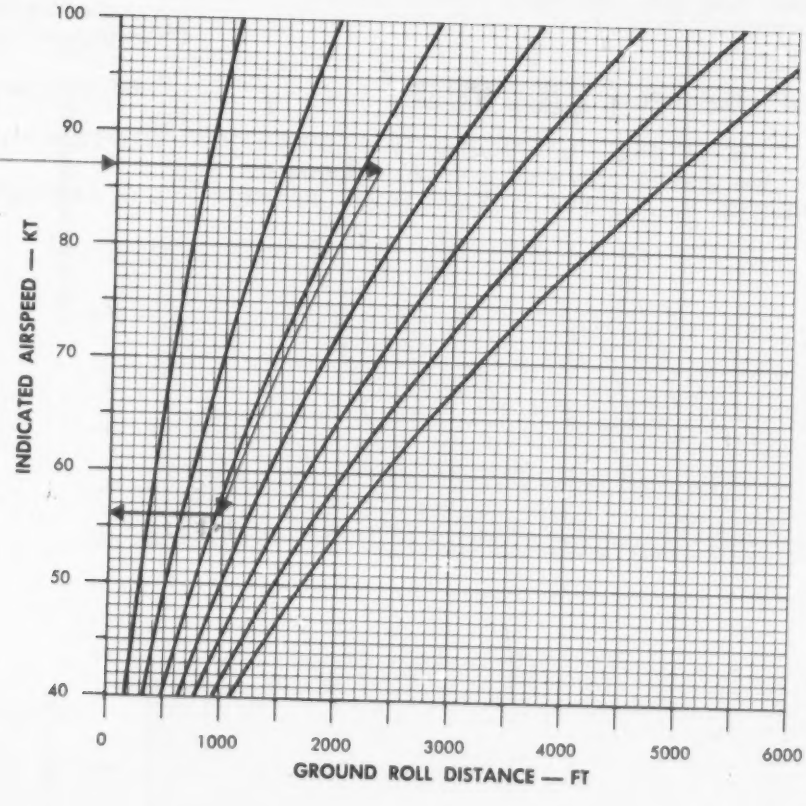
AIRSPEED REQUIRED AT VARIOUS ACCELERATION CHECK POINTS

KNOWN

TAKEOFF AIRSPEED FOR A TAKEOFF WEIGHT OF 6620 LB = 87 KT
GROUND ROLL DISTANCE = 2350 FT

METHOD

ENTER INDICATED AIRSPEED HERE
MOVE RIGHT TO GROUND ROLL DISTANCE LINE
MOVE DOWN PARALLELING THE GUIDELINE TO THE 1000 FT GROUND ROLL DISTANCE LINE
MOVE LEFT, READ INDICATED AIRSPEED REQUIRED AT 1000 FT MARKER = 56 KT



DATA BASIS: ESTIMATED

AP 001999

Figure 7-16. Acceleration Check Distance (RU-8D)

Section IX. MINIMUM SINGLE ENGINE CONTROL AIRSPEED

7-48. Description U-8D U-8G

The Minimum Single-Engine Control Airspeed Chart (figure 7-17) shows the minimum airspeed (Vmc) which will allow aircraft control during single-engine operation for various air temperatures and altitudes. Directional control of the aircraft cannot be maintained for speeds below the rudder limit line with one engine operating at takeoff power.

7-49. Use of Chart. U-8D U-8G

Use of this chart to obtain the minimum single-engine control airspeed (Vmc) is shown by Example IX-1. Flight at Vmc implies aircraft control only and does not provide the pilot wit single-engine rate-of-climb information.

7-50. Conditions. U-8D U-8G

a. Operating Engine – Operating at takeo power, 3400 RPM with manifold pressure set accor ing to the Manifold Pressure Available for Takeo Chart (figure 7-10).

b. Inoperative Engine – Propeller windmi ling.

c. Flaps — UP.

d. Landing Gear — DOWN.

GREEN
RED

MINIMUM SINGLE-ENGINE CONTROL AIRSPEED (Vmc)

TAKEOFF POWER - 3400 RPM
GEAR DOWN · FLAPS 0 DEGREES PROPELLER WINDMILLING

MINIMUM SINGLE-ENGINE CONTROL AIRSPEED (Vmc)
U-8D, U-8G
O-480-1

EXAMPLE IX-1

WANTED

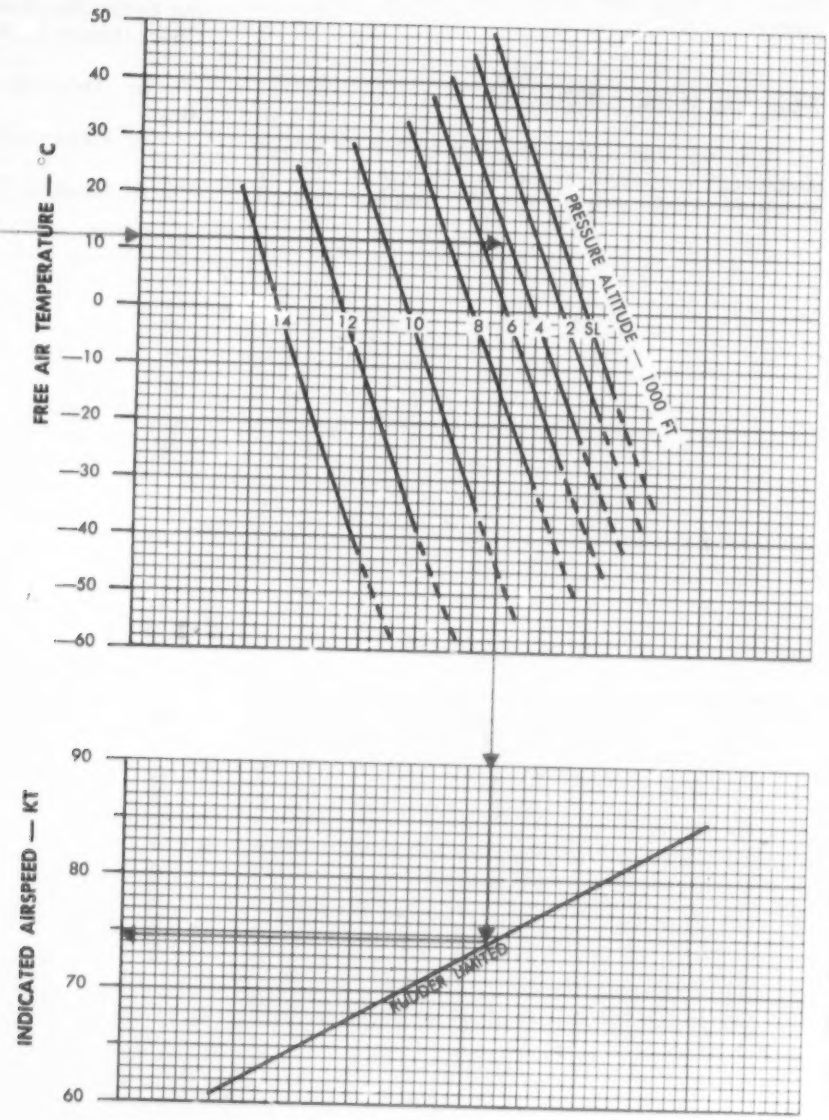
MINIMUM SINGLE-ENGINE CONTROL AIRSPEED AT A GIVEN FAT AND PRESSURE ALTITUDE

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO LINE
MOVE LEFT, READ MINIMUM CONTROL INDICATED AIRSPEED = 75 KTS



AP 001868

Figure 7-17. Minimum Single-Engine Control Airspeed (U-8D, U-8G)

7-51. Description. RU-8D

The Minimum Single-Engine Control Airspeed Chart (figure 7-18) shows the minimum airspeed (Vmc) which will allow aircraft control during single-engine operation for various air temperatures and altitudes. Directional control of the aircraft cannot be maintained for speeds below the rudder limit line with one engine operating at takeoff power.

7-52. Use of Chart. RU-8D

Use of this chart to obtain the minimum single-engine control airspeed (Vmc) is shown by Example IX-2. Flight at Vmc implies aircraft control only and does not provide the pilot with single-engine rate-of-climb information.

7-53. Conditions. RU-8D

a. Operating Engine — Operating at takeoff power, 3400 RPM with manifold pressure set according to the Manifold Pressure Available for Takeoff Chart (figure 7-10).

b. Inoperative Engine - Propeller Windmilling.

c. Flaps — UP.

d. Landing Gear — DOWN.

GREEN
RED

MINIMUM SINGLE-ENGINE CONTROL AIRSPEED (Vmc)

TAKEOFF POWER - 3400 RPM
GEAR DOWN FLAPS 0 DEGREES PROPELLER WINDMILLING

MINIMUM SINGLE-ENGINE CONTROL AIRSPEED (Vmc)
RU-8D
O-480-1

EXAMPLE IX-2

WANTED

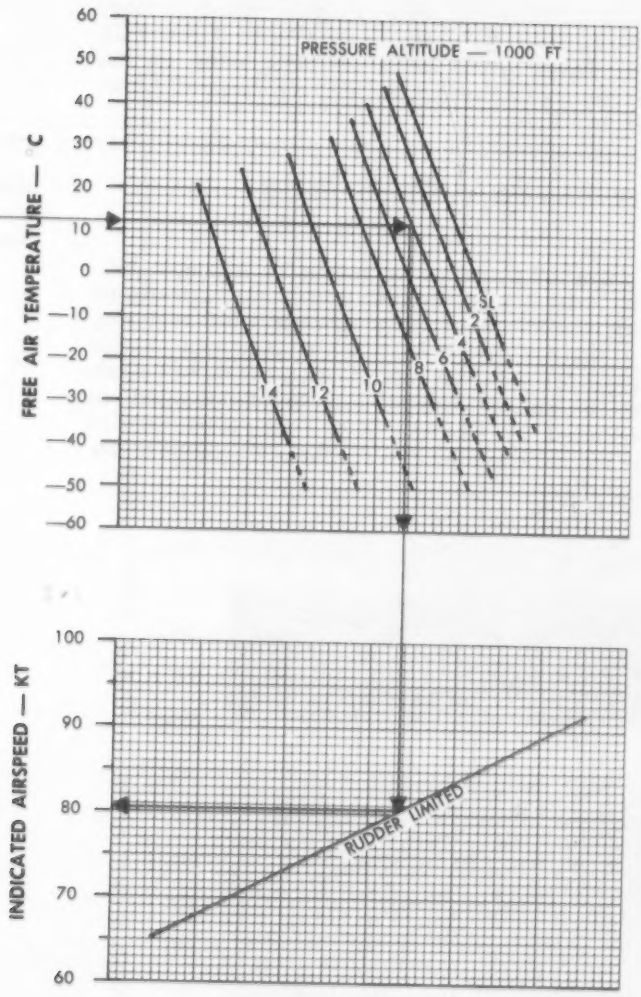
MINIMUM SINGLE-ENGINE CONTROL AIRSPEED AT A GIVEN FAT AND PRESSURE ALTITUDE

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO LINE
MOVE LEFT, READ MINIMUM CONTROL INDICATED AIRSPEED = 80 KTS - IAS



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 002059

Figure 7-18. Minimum Single-Engine Control Airspeed (RU-8D)

Section X. SINGLE ENGINE CLIMB

7-54. Description. U-8D U-8G

The Single-Engine Climb Chart (figure 7-19) shows the one engine inoperative takeoff rate-of-climb for varying air temperatures, altitudes, and weights for the gear down and gear up configurations. For single-engine cruise information refer to the Cruise Charts, (figure 7-25 thru figure 7-35) and for Vmc refer to the Minimum Single-Engine Control Airspeed Chart (figure 7-17).

7-55. Use of Chart. U-8D U-8G

Use of the chart is shown by Example X-1. This chart is to be used to determine single-engine performance in the event of engine failure during the takeoff and initial climb segments. Either weight for a desired rate-of-climb, or rate-of-climb for a known weight can be determined as illustrated by Example X-1. Performance within the red zone(s) indicates the lack of positive climb capability.

7-56. Conditions. U-8D U-8G

a. Operating engine — Operate at takeoff power. 3400 RPM according to the Manifold Pressure Available for Takeoff Chart (figure 7-10).

b. Inoperative Engine - Propeller FEATHER.

c. Flaps — UP.

d. Landing gear — UP.

e. Technique — Achieve and maintain the obstacle clearance airspeed appropriate to the weight. Refer to Normal Rotation/Takeoff Airspeed chart (figure 7-13).

NOTE

Refer to Normal Rotation/Takeoff Airspeed Chart (figure 7-13). Gear down rates-of-climb are based on climb at the scheduled takeoff airspeed. Gear up rates of climb are based on climb at the scheduled obstacle clearance airspeed.

GREEN
RED

SINGLE-ENGINE CLIMB
TAKEOFF CONFIGURATION — 3400 RPM
FLAPS 0 DEGREES PROPELLER FEATHERED POWER-TAKEOFF

SINGLE-ENGINE CLIMB
U-8D, U-8G
O-480-1

EXAMPLE X-1

WANTED

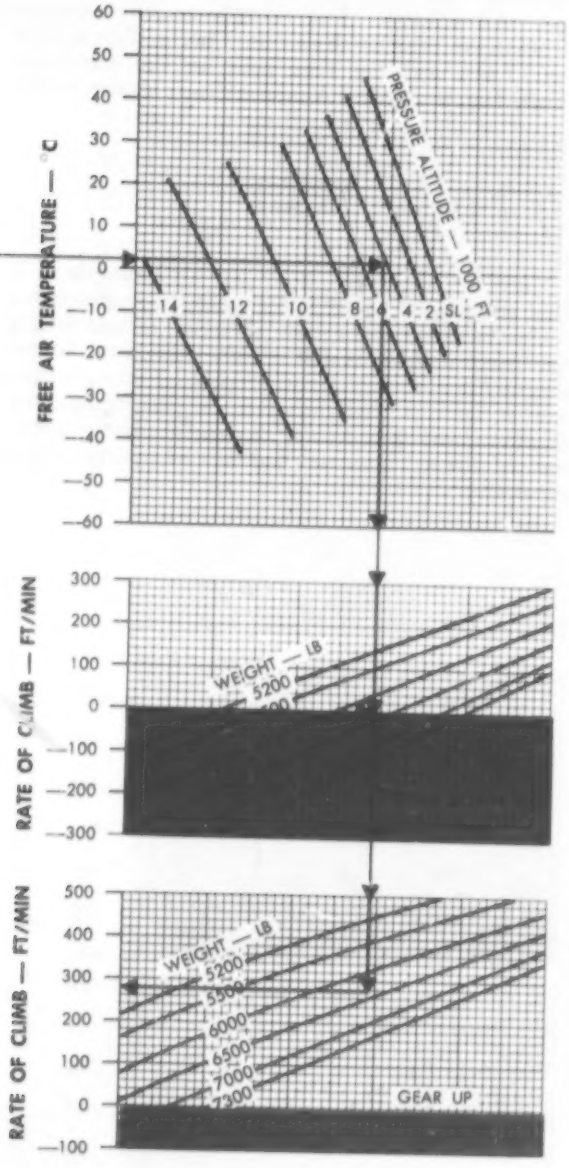
WEIGHT TO OBTAIN A POSITIVE SINGLE-ENGINE R/C AT LIFTOFF AND SINGLE-ENGINE R/C AFTER THE GEAR IS RETRACTED

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO 0 FT/MIN R/C FOR GEAR DOWN, READ WEIGHT TO OBTAIN POSITIVE R/C AT LIFTOFF = 6180 LB
MOVE DOWN TO WEIGHT = 6180 FOR GEAR UP CLIMB
MOVE LEFT, READ SINGLE ENGINE R/C AFTER GEAR RETRACTION = 280 FT/MIN



DATA BASIS: ESTIMATED

AP 001969

Figure 7-19. Single-Engine Climb (U-8D, U-8G)

7-57. Description. RU-8D

The Single-Engine Climb Chart (figure 7-19) shows the one engine inoperative takeoff rate-of-climb for varying air temperatures, altitudes, and weights for the gear down and gear up configurations. For single-engine cruise information refer to the Cruise Charts, (figure 7-36 thru 7-46) and for Vmc refer to the Minimum Single-Engine Control Airspeed Chart (figure 7-18).

7-58. Use of Chart. RU-8D

Use of the chart is shown by Example X-2. This chart is to be used to determine single-engine performance in the event of engine failure during the takeoff and initial climb segments. Either weight for a desired rate-of-climb, or rate-of-climb for a known weight can be determined as illustrated by Example X-2. Performance within the red zone(s) indicates the lack of positive climb capability.

7-59. Conditions. RU-8D

a. Operating Engine — Operating at takeoff power, 3400 RPM according to the Manifold Pressure Available for Takeoff Chart (figure 7-10).

b. Inoperative Engine — Propeller FEATHER.

c. Flaps — UP.

d. Landing gear — UP.

e. Technique - Achieve and maintain the obstacle clearance airspeed appropriate to the weight. Refer to Normal Rotation/Takeoff Airspeed chart (figure 7-14).

NOTE

Refer to Normal Rotation/Takeoff Airspeed Chart (figure 7-14). Gear down rates-of-climb are based on climb at the scheduled takeoff airspeed. Gear up rates of climb are based on climb at the scheduled obstacle clearance airspeed.

GREEN
RED

SINGLE-ENGINE CLIMB
TAKEOFF CONFIGURATION — 3400 RPM

SINGLE-ENGINE CLIMB
RU-8D
O-480-1

EXAMPLE X-2

WANTED

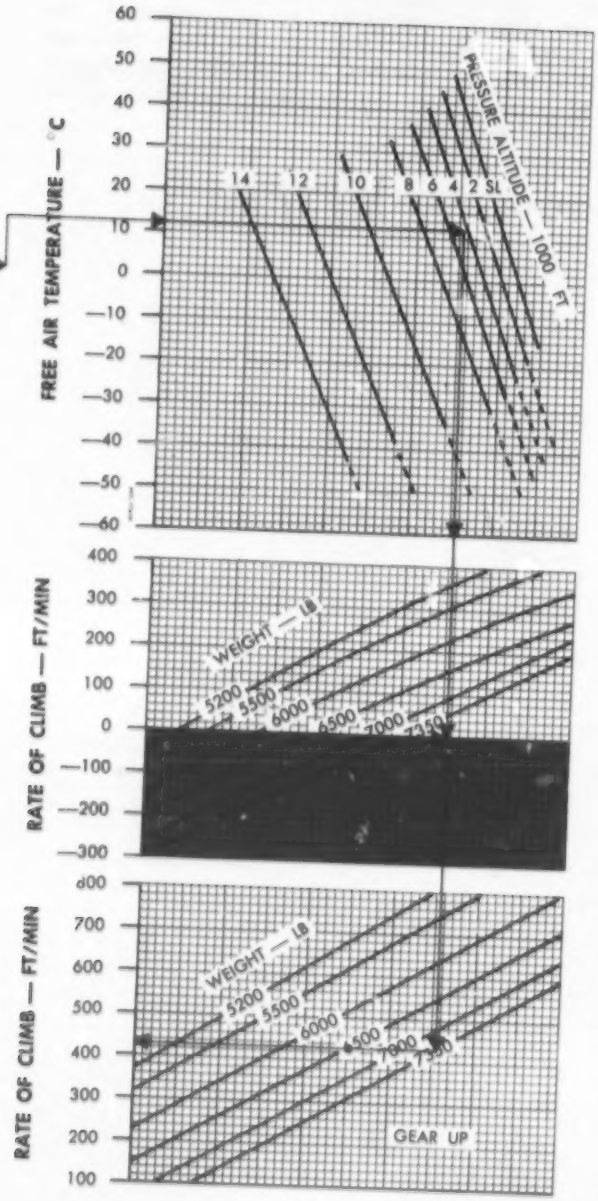
WEIGHT TO OBTAIN A POSITIVE SINGLE-ENGINE R/C AT LIFTOFF AND SINGLE-ENGINE R/C AFTER THE GEAR IS RETRACTED

KNOWN

FAT = 12°C
PRESSURE ALTITUDE = 4307 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO FT/MIN R/C FOR GEAR DOWN,
READ WEIGHT TO OBTAIN POSITIVE R/C AT LIFTOFF = GREATER THAN 7350 LB
MOVE DOWN TO WEIGHT = 7350 LB FOR GEAR UP,
READ SINGLE-ENGINE R/C AFTER GEAR RETRACTION = 430 FT/MIN



AP 001998

DATA BASIS: DERIVED FROM FLIGHT TEST

Figure 7-20. Single-Engine Climb (RU-8D)

Section XI. OPERATIONAL ENVELOPE

7-60. Description. U-8D U-8G

The Operation Envelope Chart (figure 7-21) shows the maximum temperatures for which operation is permitted; the minimum temperatures for which operation is recommended; the maximum altitudes possible for both two and single-engine operations; and identifies the altitude and temperature combinations for which Cruise Charts are available.

7-61. Use of Chart. U-8D U-8G

Use of the Operation Envelope Chart is shown by Example XI-1. This chart is used to determine if the proposed flight is within the operational temperature/altitude envelope and to identify the temperature and altitude combinations which should be used for flight planning.

7-62. Conditions. U-8D U-8G

Service ceilings are based on the aircraft with gear and flaps up.

GREEN
RED

OPERATION ENVELOPE

OPERATION ENVELOPE
U-8D, U-8G
O-480-1

EXAMPLE XI-1

WANTED

DETERMINE IF FLIGHT IS WITHIN THE OPERATION ENVELOPE. DETERMINE THE CRUISE CHARTS TO USE FOR PERFORMANCE PLANNING

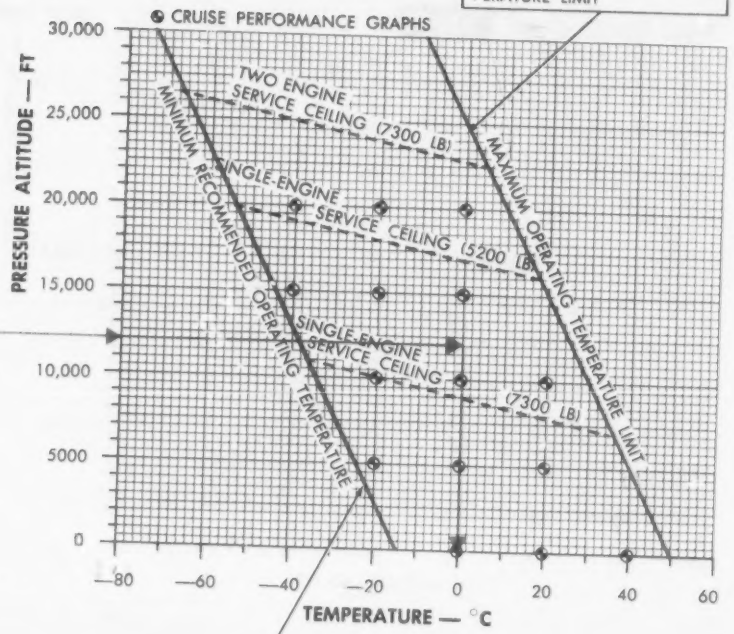
KNOWN

PRESSURE ALTITUDE = 12,000 FT
FAT = 0.5°C

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO FAT = 0.5°C,
OPERATION IS WITHIN ENVELOPE
USE CRUISE CHARTS FOR 0°C
AT 10,000 FT AND 15,000 FT

NO AIRCRAFT PERFORMANCE OR ENGINE OPERATING CHARACTERISTICS HAVE BEEN DEMONSTRATED ABOVE THE MAXIMUM OPERATING TEMPERATURE LIMIT



AIRCRAFT OPERATION BELOW MINIMUM RECOMMENDED OPERATING TEMPERATURES IS SHOWN ON PERFORMANCE CHARTS AS DASHED LINES

DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001960

Figure 7-21. Operation Envelope (U-8D, U-8G)

7-63. Description. RU - 8D

The Operation Envelope Chart (figure 7-22) shows the maximum temperatures for which operation is permitted; the minimum temperatures for which operation is recommended; the maximum altitudes possible for both two and single-engine operations; and identifies the altitude and temperature combinations for which Cruise Charts are available.

7-64. Use of Chart. RU - 8D

Use of the Operation Envelope Chart is shown by Example XI-2. This chart is used to determine if the proposed flight is within the operational temperature/altitude envelope and to identify the temperature and altitude combinations which should be used for flight planning.

7-65. Conditions. RU - 8D

Service ceilings are based on the aircraft with gear and flaps up.

GREEN
RED

OPERATION ENVELOPE

OPERATION ENVELOPE
RU-8D
O-480-1

EXAMPLE XI-2

WANTED

DETERMINE IF FLIGHT IS WITHIN THE OPERATIONAL ENVELOPE. DETERMINE THE CRUISE CHARTS TO USE FOR PERFORMANCE PLANNING

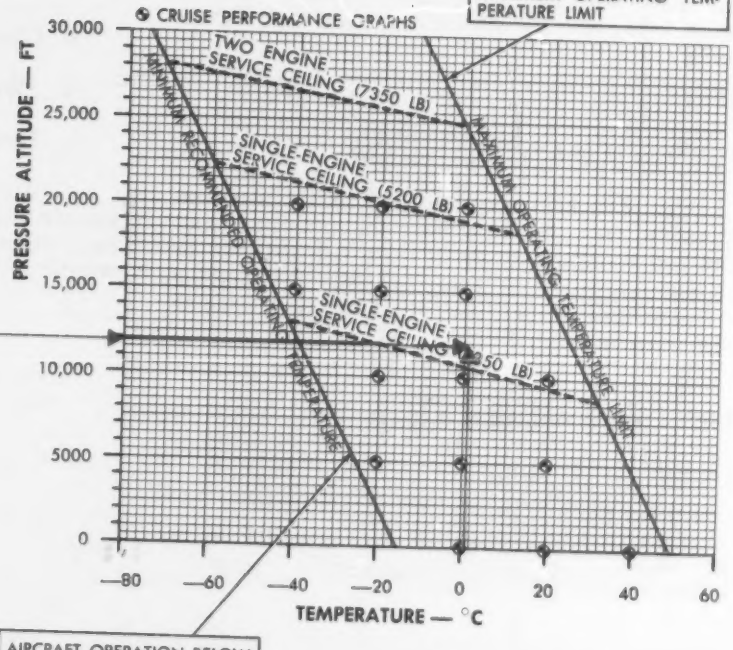
KNOWN

PRESSURE ALTITUDE = 12,000 FT
FAT = 0.5°C

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO FAT = 0.5°C,
OPERATION IS WITHIN ENVELOPE
USE CRUISE CHARTS FOR 0°C AND 20°C
AT 10,000 FT AND 15,000 FT

NO AIRCRAFT PERFORMANCE OR ENGINE OPERATING CHARACTERISTICS HAVE BEEN DEMONSTRATED ABOVE THE MAXIMUM OPERATING TEMPERATURE LIMIT



AIRCRAFT OPERATION BELOW MINIMUM RECOMMENDED OPERATING TEMPERATURES ARE SHOWN ON PERFORMANCE CHARTS AS DASHED LINES

DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001902

Figure 7-22. Operation Envelope (RU-8D)

Section XII. CRUISE CLIMB

7-66. Description. U-8D U-8G

The Cruise Climb Chart (figure 7-23) shows the time, fuel, and distance required to climb from sea level. For climb at other than the conditions of this chart, refer to Cruise Charts (figure 7-25 thru figure 7-35) and the Climb/Descent Chart (figure 7-47).

7-67. Use of Chart. U-8D U-8G

Use of the Cruise Climb Chart is shown by Example XII-1. To determine the time, fuel and distance required to climb from one altitude to another, subtract the time, fuel and distance for initial altitude from values for the final altitude as shown by Example XII-1.

7-68. Condition. U-8D U-8G

a. Power — Maximum cruise climb power at 3200 RPM.

b. Mixture — Fuel flow appropriate to pressure altitude as indicated on Cruise Climb Chart (figure 7-23).

c. Climb speed — 110 KIAS.

d. Flaps — UP.

e. Landing gear — UP.

f. Atmosphere — Temperature lapse rate is assumed to be linear from the initial altitude to the final altitude. Distances to climb are based on calm wind.

NOTE

Time and fuel to climb are not affected by wind.

GREEN

CRUISE CLIMB

CLIMB SPEED 110 KNOTS
FLAPS 0 DEGREES GEAR UP CALM WINDS
POWER-CRUISE CLIMB-3200 RPM

CRUISE CLIMB
U-8D, U-8G
O-480-1

EXAMPLE XII-1

WANTED

TIME FUEL AND DISTANCE TO CLIMB

KNOWN

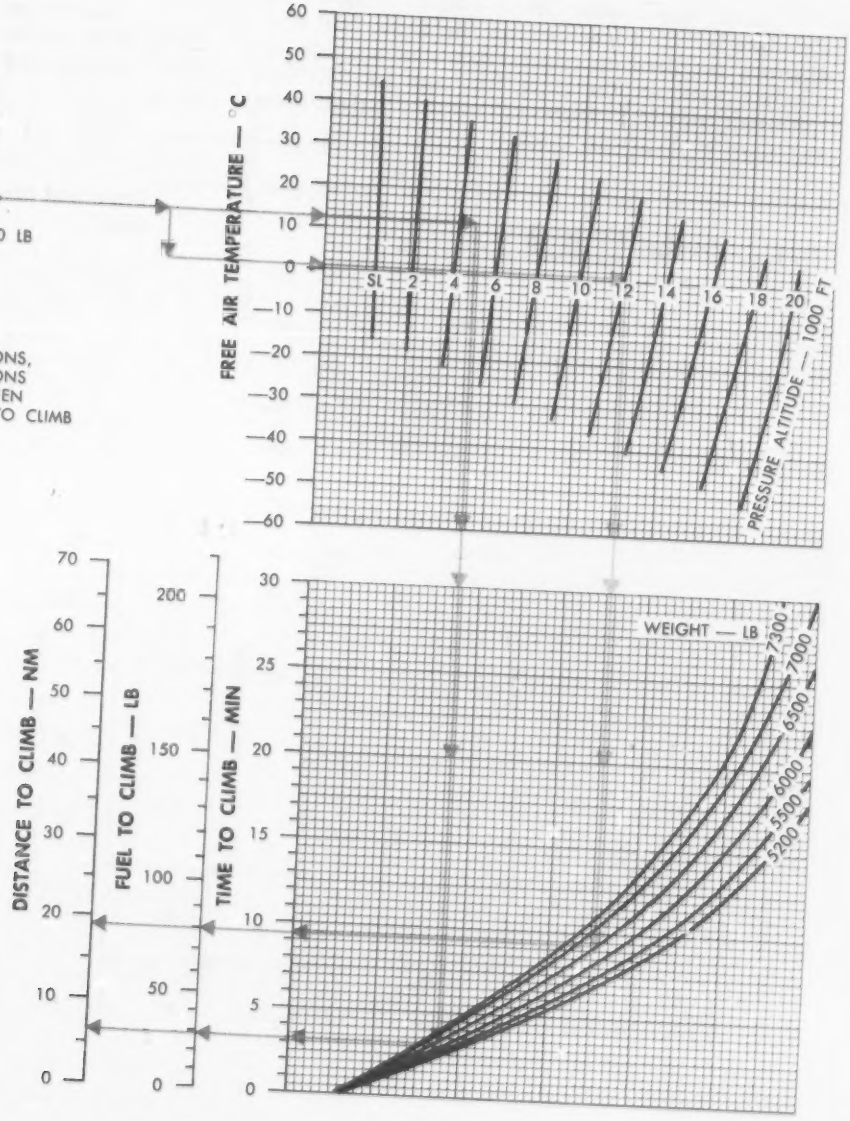
INITIAL FAT = 12°C
INITIAL PRESSURE ALTITUDE = 4307 FT
INITIAL WEIGHT = 6620 LB
FINAL FAT = 0.5°C
FINAL PRESSURE ALTITUDE = 12,000 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO INITIAL WEIGHT = 6620 LB
MOVE LEFT AND READ TIME FUEL AND DISTANCE TO CLIMB

NOTE

FIRST, READ GRAPH FOR INITIAL CONDITIONS, AND SECOND, READ FOR FINAL CONDITIONS WITH INITIAL WEIGHT. DIFFERENCE BETWEEN READINGS IS TIME, FUEL AND DISTANCE TO CLIMB
TIME TO CLIMB (9—3) = 6 MIN
FUEL TO CLIMB (80—29) = 51 LB
DISTANCE TO CLIMB (19—7) = 12 NM



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001971

Figure 7-23. Cruise Climb (U-8D, U-8G)

7-69. Description. RU - 8D

The Cruise Climb Chart (figure 7-24) shows the time, fuel, and distance required to climb from sea level. For climb at other than the conditions of this chart, refer to Cruise Charts (figure 7-36 thru figure 7-46) and the Climb/Descent Chart (figure 7-48).

7-70. Use of Chart. RU , 8D

Use of the Cruise Climb Chart is shown by Example XII-2. To determine the time, fuel and distance required to climb from one altitude to another, subtract the time, fuel and distance for initial altitude from the values for the final altitude as shown by Example XII-2.

7-71. Condition. RU - 8D

a. Power — Maximum cruise climb power at 3200 RPM.

b. Mixture — Fuel flow appropriate to pressure altitude as indicated on Cruise Climb Chart (figure 7-24).

c. Climb speed — 110 KIAS.

d. Flaps — UP.

e. Landing gear — UP.

f. Atmosphere — Temperature lapse rate is assumed to be linear from the initial altitude to the final altitude. Distances to climb are based on calm wind.

NOTE

Time and fuel to climb are not affected by wind.

GREEN

CRUISE CLIMB
CLIMB SPEED — 100 KNOTS
FLAPS 0 DEGREES GEAR UP CALM WINDS
POWER — 3200 RPM

CRUISE CLIMB
RU-8D
O-480-1

EXAMPLE XII-2

WANTED

TIME, FUEL, AND DISTANCE TO CLIMB

KNOWN

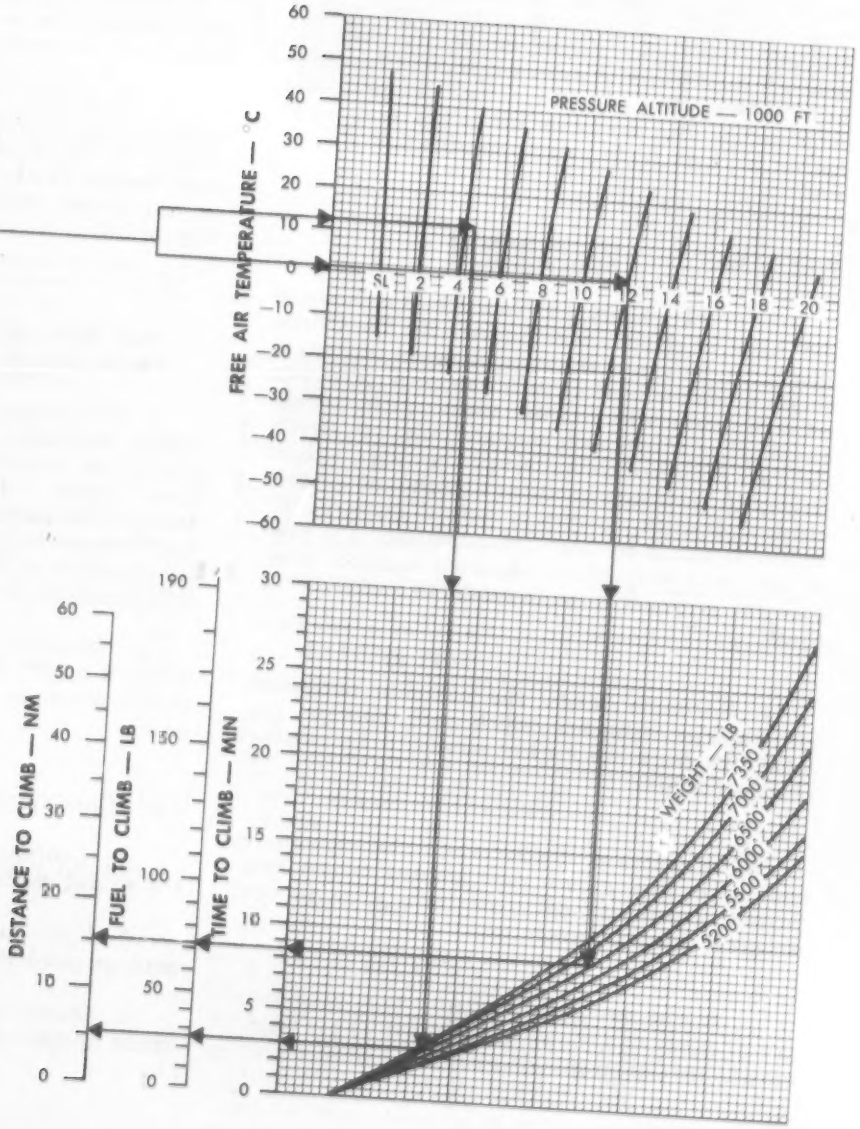
INITIAL FAT = 12°C
INITIAL PRESSURE ALTITUDE = 4307 FT
INITIAL WEIGHT = 6620 LB
FINAL FAT = 0.5°C
FINAL PRESSURE ALTITUDE = 12,000 FT

METHOD

ENTER FAT HERE
MOVE RIGHT TO PRESSURE ALTITUDE
MOVE DOWN TO INITIAL WEIGHT
MOVE LEFT, AND READ TIME, FUEL, AND DISTANCE TO CLIMB

NOTE

FIRST READ GRAPH FOR INITIAL CONDITIONS, AND SECOND, READ FOR FINAL CONDITIONS WITH INITIAL WEIGHT. DIFFERENCE BETWEEN READINGS IS TIME, FUEL AND DISTANCE TO CLIMB
TIME TO CLIMB (9 − 3) = 6 MIN
FUEL TO CLIMB (72 − 26) = 46 LB
DISTANCE TO CLIMB (15 − 5) = 10 NM



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 002060

Figure 7-24. Cruise Climb (RU-8D)

Section XIII. CRUISE

7-72. Description. U-8D U-8G

The Cruise Charts (figure 7-25 thru figure 7-35) show the horsepower per engine for various airspeeds and weights at selected combinations of altitude and temperature. Cruise and climb fuel flows are shown corresponding to engine power. Maximum performance lines are shown. Manifold pressure variation with propeller speed and engine horsepower are shown. Two engine and single-engine data are presented on the chart. Each individual chart is for a single pressure altitude and FAT.

7-73. Use of Chart. U-8D U-8G

The primary use of the Cruise Chart is shown in the Cruise Example Chart (figure 7-25). The Cruise Charts are for use in determining power settings to obtain a desired level of performance for a known set of conditions of altitude, temperature, weight and number or operating engines. Normally, sufficient accuracy can be obtained by selecting the chart nearest to the planned cruising altitude and temperature. If greater accuracy is desired, interpolation betwen two or more charts should be used. The power setting is obtained by adjusting manifold pressure and propeller speed to values indicated on the chart.

a. Maximum Range. The maximum range line shows the airspeed which will provide the maximum range for a given aircraft weight at the chart conditions.

b. Maximum Endurance. The maximum endurance line shows the airspeed which will provide maximum endurance for a given aircraft weight at the chart conditions.

c. Maximum Rate-of-Climb. The maximum rate-of-climb line shows the airspeed which would provide maximum rate-of-climb for a given aircraft weight if maximum horsepower was used at the chart conditions.

d. Airspeed. The relationship between indicated and true airspeed is shown for the specific chart conditions of altitude and temperature. Conversion between the two airspeeds can be accomplished without regard to other chart information.

e. Fuel Flow. The fuel flow for cruise and climb settings is shown. Horsepower can be equated directly to fuel flow without regard to other chart information. To convert fuel flow to gallons per hour or pounds per hour refer to the Fuel Flow Chart (figure 7-9).

NOTE

Fuel flow values should be doubled for two engine operation.

f. Horsepower Per Engine. Horsepower per engine, although not readable in the cockpit is utilized in conjunction with the Climb/Descent Chart (figure 7-47) to obtain rate-of-climb or descent. The maximum horsepower line represents the horsepower which can normally be expected for operation at 3400 RPM and full throttle, and is not considered limiting.

g. Manifold Pressure. The relationship between manifold pressure, engine speed, and fuel flow is shown to enable the pilot to set the desired power.

7-74. Conditions. U-8D U-8G

a. Configuration. All cruise data are based on the aircraft with gear and flaps up.

b. Fuel. Fuel flow pressure is based on use of aviation gasoline 100/130.

c. Operation. Areas not recommended for cruise operation are shown in yellow.

GREEN
BLUE
RED

CRUISE
PRESSURE ALTITUDE 12,000 FT EXAMPLE
FLAPS 0 DEGREES 100/130 FUEL GEAR UP

CRUISE
U-8D, U-8G
O-480-1

EXAMPLE XIII-1

WANTED

TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER PER ENGINE AND MANIFOLD PRESSURE PER ENGINE FOR MAX RANGE CRUISE

KNOWN

WEIGHT = 6250 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = 0°C
ENGINE RPM = 2600

METHOD 1 (SIMPLEST)

USE CHART FOR NEXT HIGHER CONDITION (15,000 FT)
ENTER MAX RANGE HERE
MOVE RIGHT AND UP TO WEIGHT = 6250 LB
MOVE LEFT, READ TRUE AIRSPEED = 146 KT
MOVE RIGHT, READ INDICATED AIRSPEED = 112 KT
MOVE DOWN, READ HORSEPOWER PER ENGINE = 143 HP
MOVE DOWN, READ FUEL FLOW PER ENGINE = 11.2 GAL/HR PER ENGINE
MOVE LEFT FROM ENGINE RPM, READ MANIFOLD PRESSURE PER ENGINE = 23.0 IN. HG.

METHOD 2 (INTERPOLATE)

READ TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER FUEL FLOW AND MANIFOLD PRESSURE AT EACH ADJACENT ALTITUDE AND OAT — THEN INTERPOLATE

ALTITUDE	10,000 FT	15,000 FT	12,000 FT
FAT	0°C	0°C	0°C
TRUE AIRSPEED	132	146	138
INDICATED AIRSPEED	112	112	112
HORSEPOWER	133	143	137
FUEL FLOW	10.3	11.2	10.7
MANIFOLD PRESSURE	22.0	23.0	22.4

EXAMPLE XIII-2

WANTED

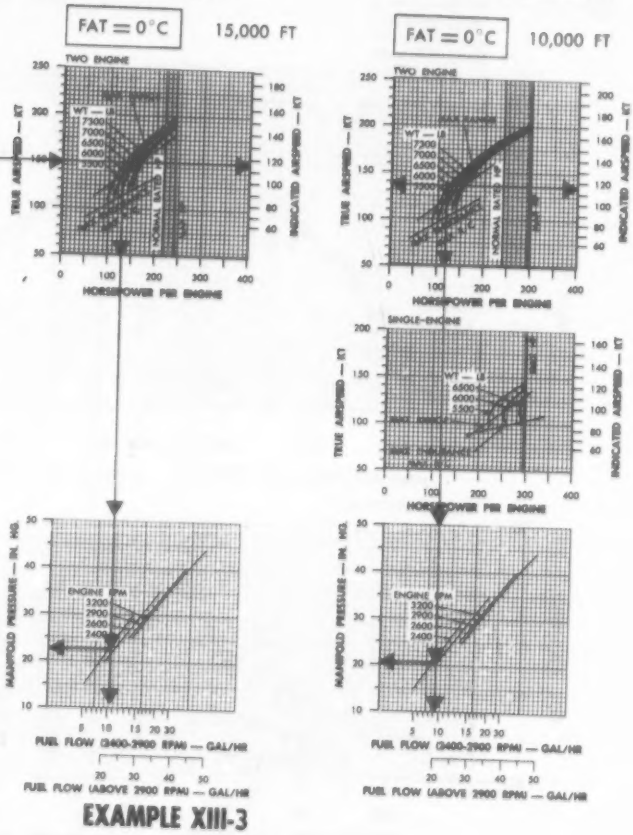
INDICATED AIRSPEED, HORSEPOWER PER ENGINE, FUEL FLOW AND MANIFOLD PRESSURE FOR A DESIRED TRUE AIRSPEED

KNOWN

DESIRED TRUE AIRSPEED = 150 KT
WEIGHT = 6250 LB
PRESSURE ALTITUDE = 15,000 FT
FAT = 0°C
ENGINE RPM = 2600

METHOD

ENTER TRUE AIRSPEED ON LEFT
MOVE RIGHT TO INDICATED AIRSPEED = 116 KT
MOVE DOWN FROM WEIGHT, READ HORSEPOWER = 148 HP
MOVE DOWN, READ FUEL FLOW = 11.7 GAL/HR PER ENGINE
MOVE LEFT FROM ENGINE RPM, READ MANIFOLD PRESSURE = 23.7 IN. HG.



EXAMPLE XIII-3

WANTED

MAX RATE-OF-CLIMB, INDICATED AIRSPEED, HORSEPOWER PER ENGINE FOR LEVEL FLIGHT AT MAX R/C AIRSPEED, MAX CONT HORSEPOWER AVAILABLE, EXCESS HORSEPOWER AVAILABLE FOR CLIMB, FUEL FLOW AND MANIFOLD PRESSURE FOR MAX CLIMB

KNOWN

WEIGHT = 6250 LB
PRESSURE ALTITUDE = 10,000 FT
FAT = 0°C
ENGINE SPEED = 2400

METHOD

ENTER CHART AT MAX R/C LINE
MOVE RIGHT AND UP TO WEIGHT = 6250
MOVE RIGHT, READ MAX R/C INDICATED AIRSPEED = 89 KT
MOVE DOWN FROM WEIGHT LINE, READ HORSEPOWER REQUIRED FOR LEVEL FLIGHT AT MAX R/C AIRSPEED = 110 HP
MOVE DOWN FROM MAX CONT HP LINE, READ MAX CONT HORSEPOWER AVAILABLE = 295 HP
MOVE DOWN FROM MAX CONT HP AVAILABLE, READ CLIMB FUEL FLOW = 44.5 GAL/HR PER ENGINE (3200 RPM)
MOVE LEFT FROM ENGINE RPM LINE, READ MANIFOLD PRESSURE TO SET FOR CLIMB = 40.5 IN. HG. (3200 RPM)
DETERMINE EXCESS HORSEPOWER PER ENGINE AVAILABLE FOR CLIMB — MAX CONT HORSEPOWER AVAILABLE LESS HORSEPOWER REQUIRED FOR LEVEL FLIGHT = 295—110 = 185 HP PER ENGINE

AP 002078

Figure 7-25. Cruise Example (U-8D, U-8G)

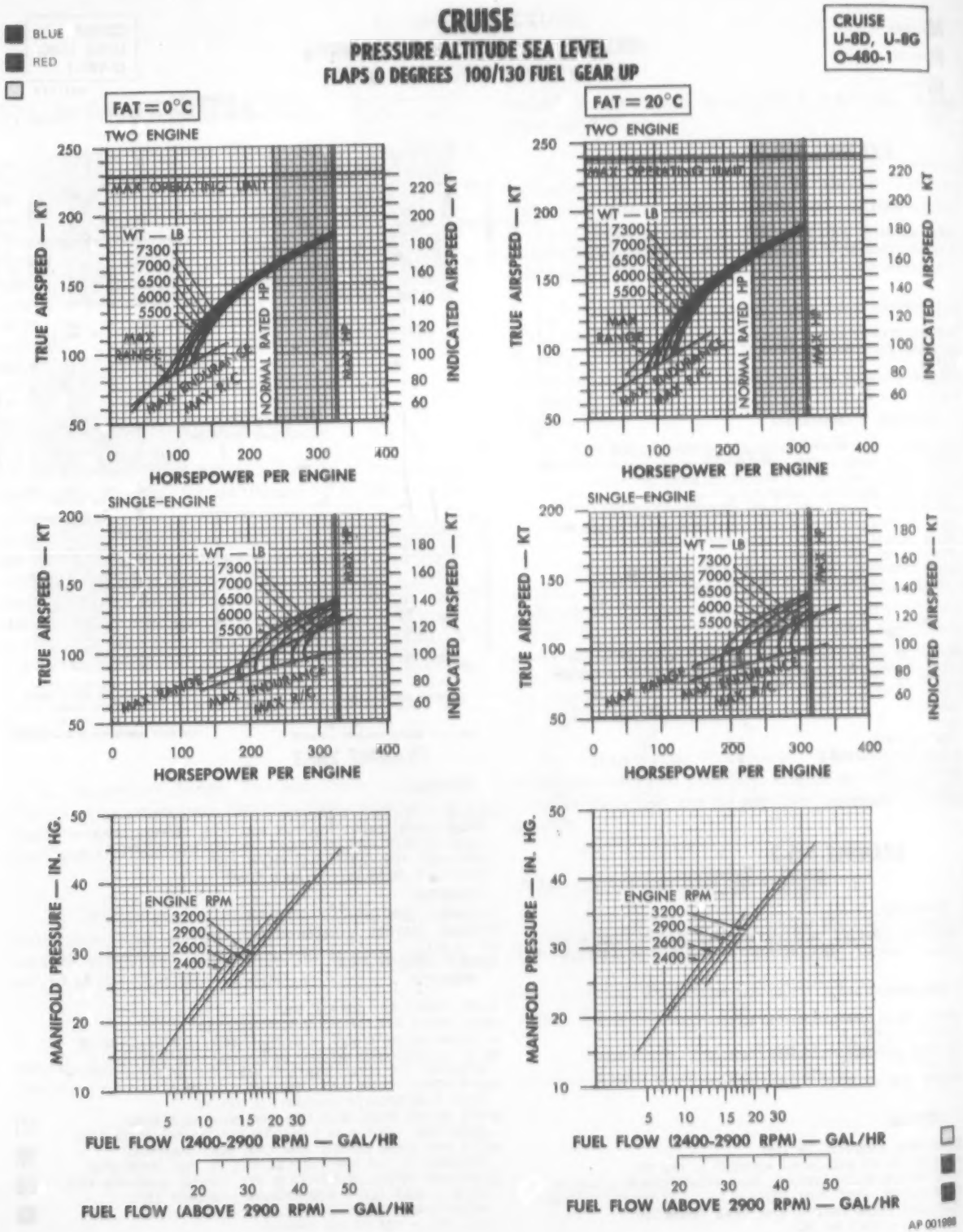


Figure 7-26. Cruise FAT O°C and 20°C, Sea Level (U-8D, U-8G)

BLUE
RED

CRUISE
U-8D, U-8G
O-480-1

CRUISE

PRESSURE ALTITUDE SEA LEVEL
FLAPS 0 DEGREES 100/130 FUEL GEAR UP

FAT = 40°C

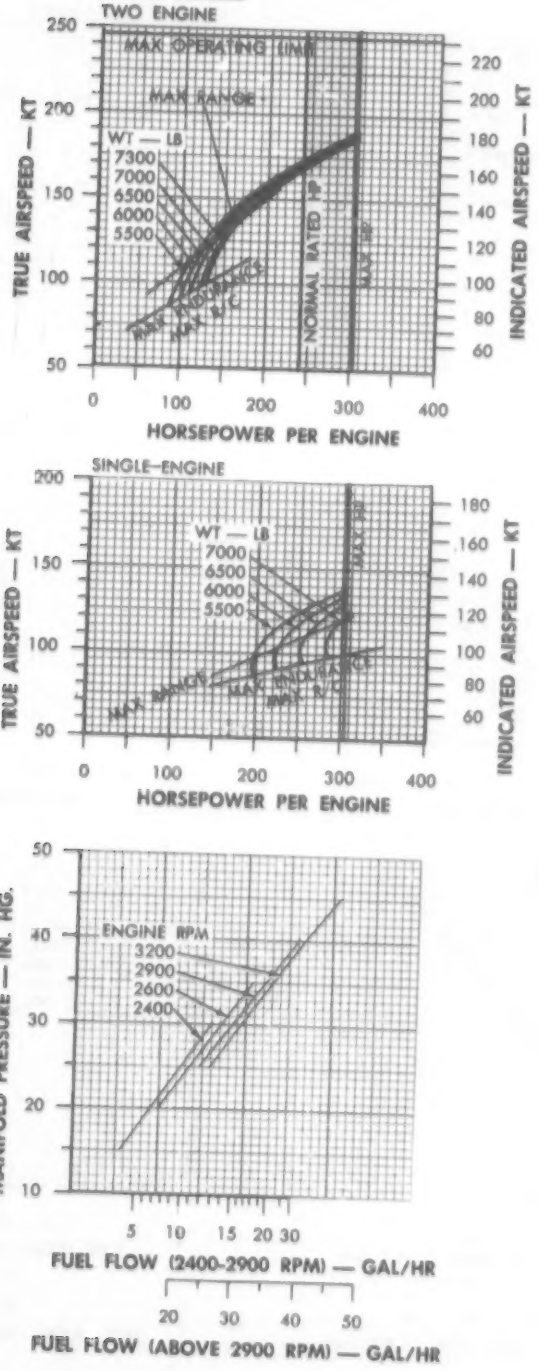


Figure 7-27. Cruise FAT 40°C, Sea Level (U-8D, U-8G)

AP 001871

BLUE
RED

CRUISE
PRESSURE ALTITUDE 5000 FT
FLAPS 0 DEGREES 100/130 FUEL GEAR UP

CRUISE
U-8D, U-8G
O-480-1

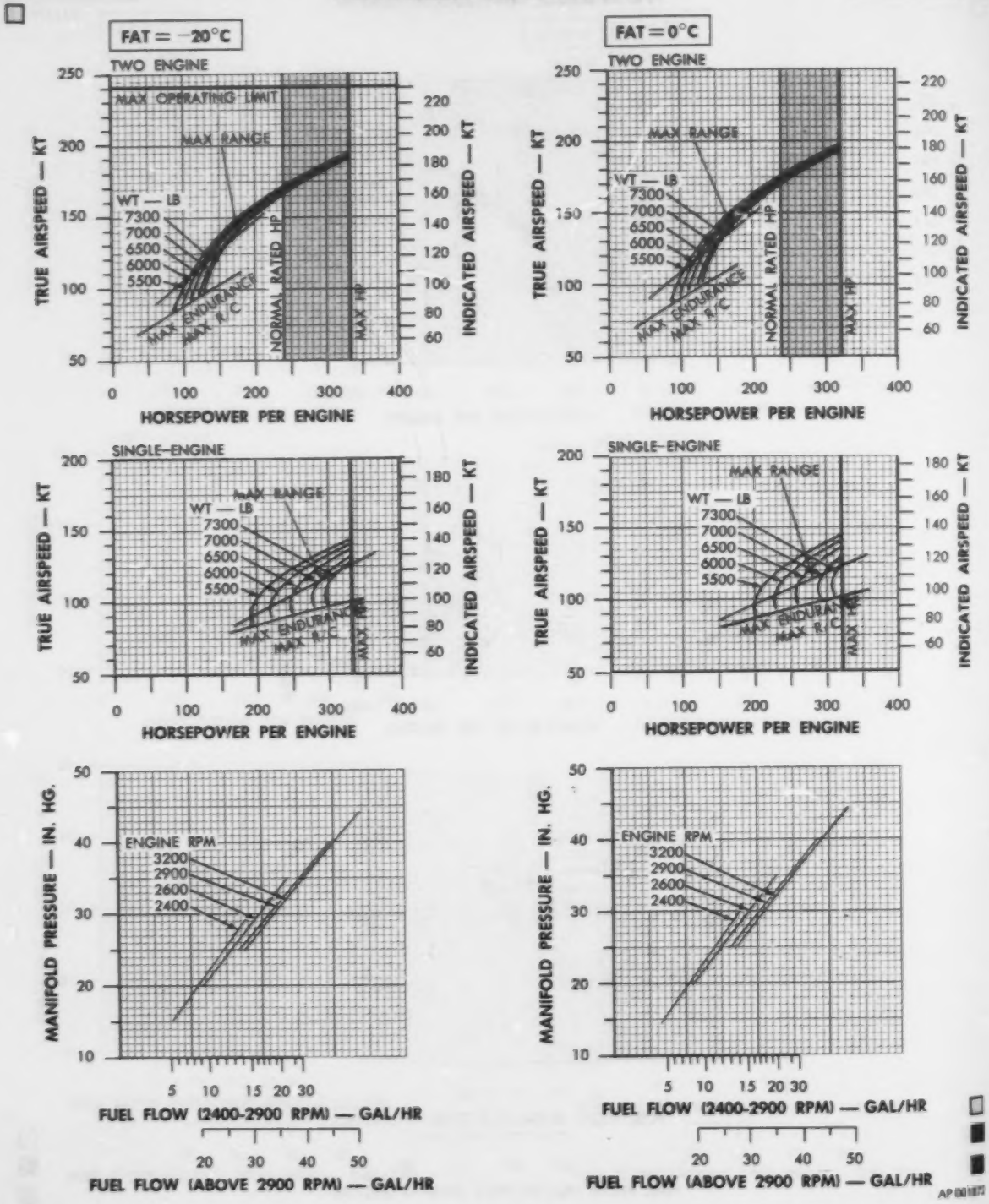


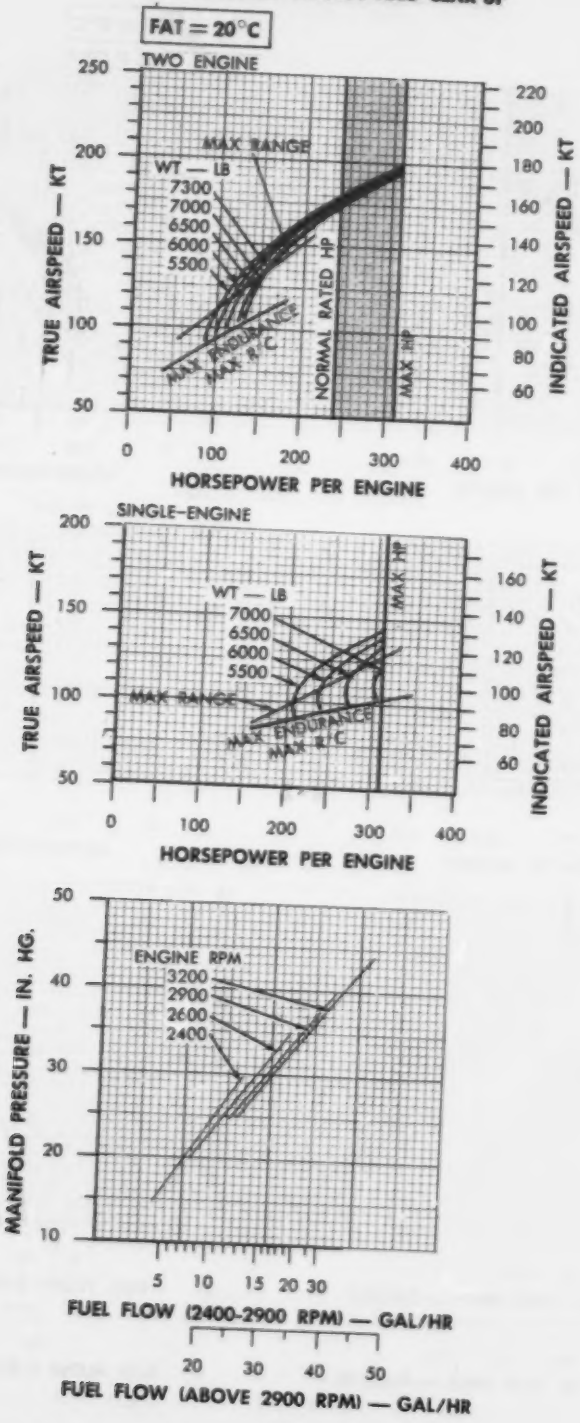
Figure 7-28. Cruise FAT −20° and 0°C, 5000 Feet (U-8D, U-8G)

BLUE
RED

CRUISE
U-8D, U-8G
O-480-1

CRUISE

PRESSURE ALTITUDE 5000 FT
FLAPS 0 DEGREES 100/130 FUEL GEAR UP



AP 001873

Figure 7-29. Cruise FAT 20° C, 5000 Feet (U-8D, U-8G)

best copy available

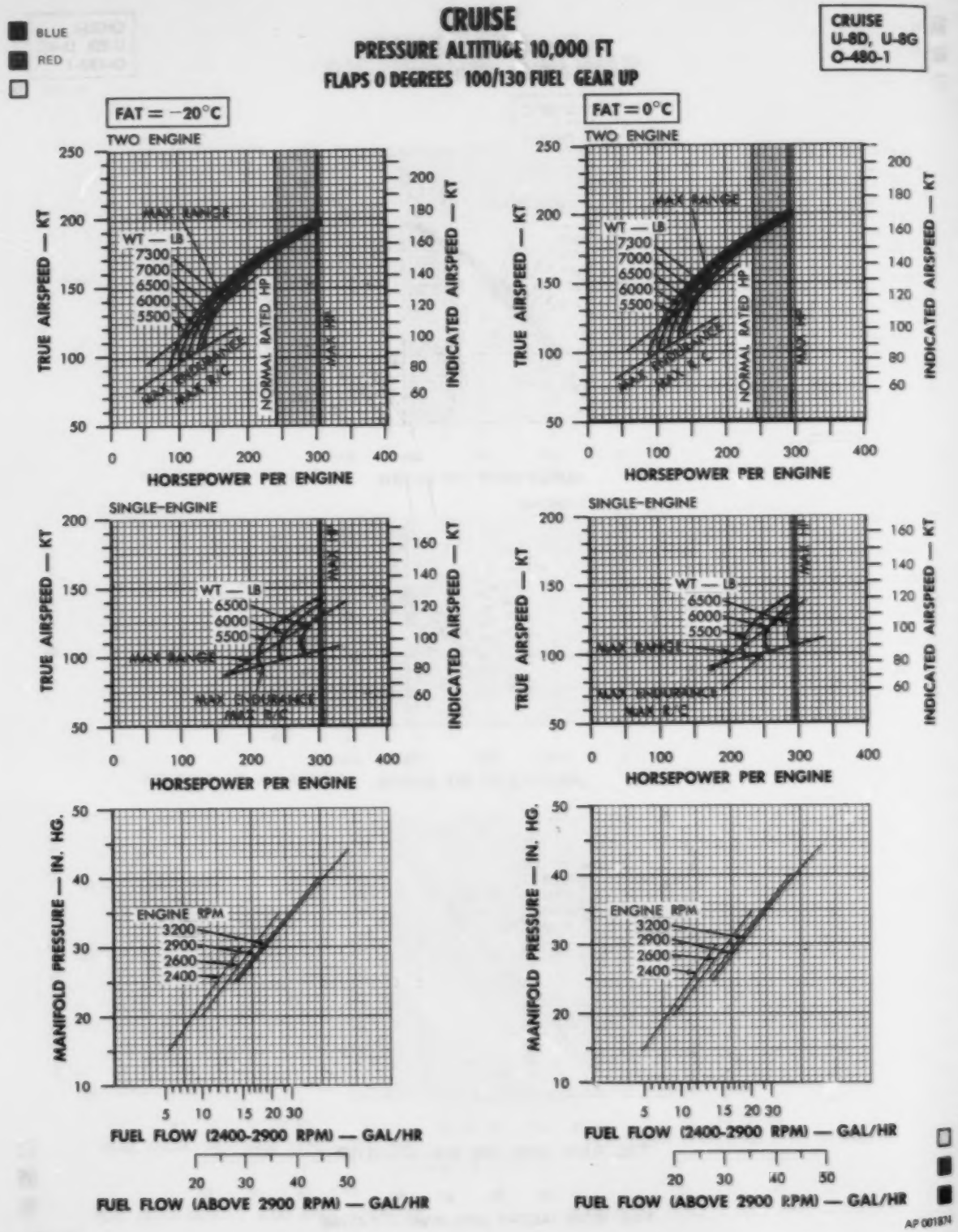


Figure 7-30. Cruise FAT −20° and 0°, 10,000 Feet (U-8D, U-8G)

BLUE
RED

CRUISE
U-8D, U-8G
O-480-1

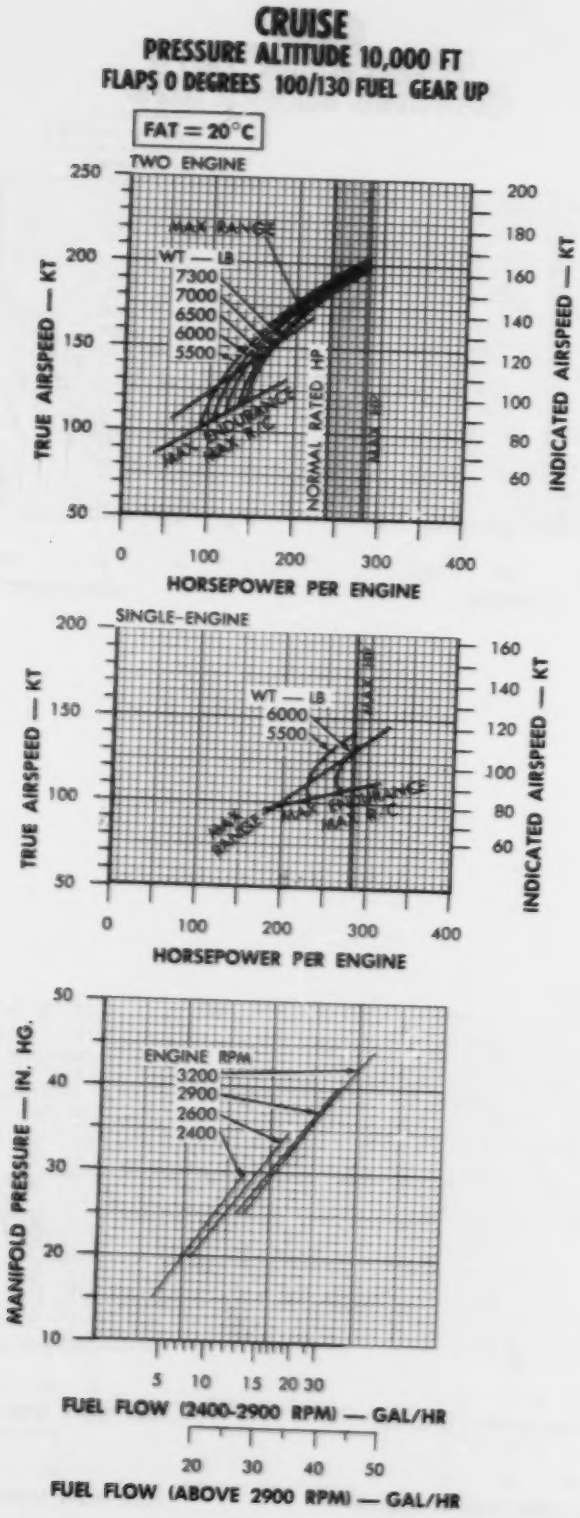


Figure 7-31. Cruise FAT 20°C, 10,000 Feet (U-8D, U-8G)

AP 001875

BLUE
RED

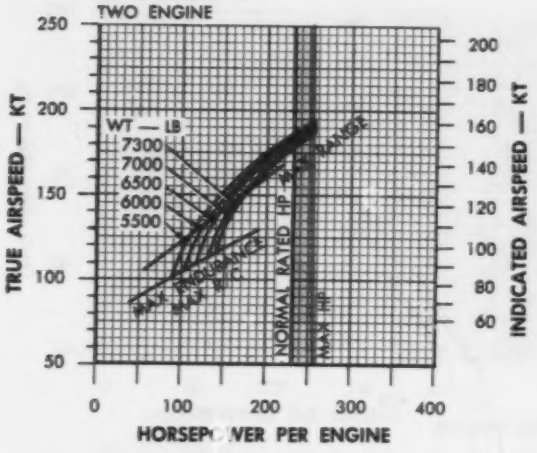
CRUISE

PRESSURE ALTITUDE 15,000 FT

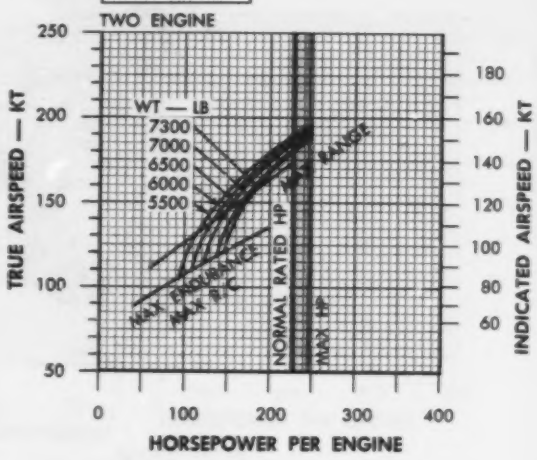
FLAPS 0 DEGREES 100/130 FUEL GEAR UP

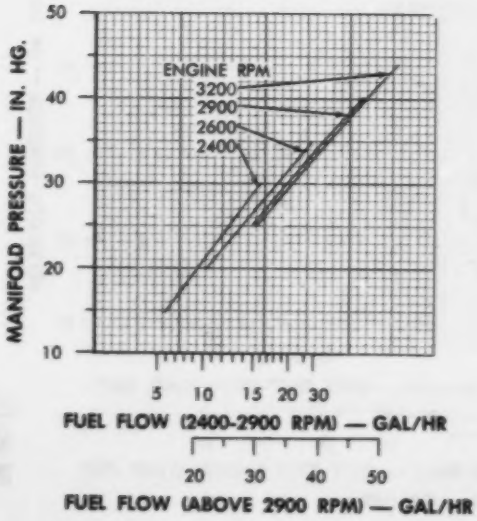
CRUISE
U-8D, U-8G
O-480-1

FAT = −40°C



FAT = −20°C





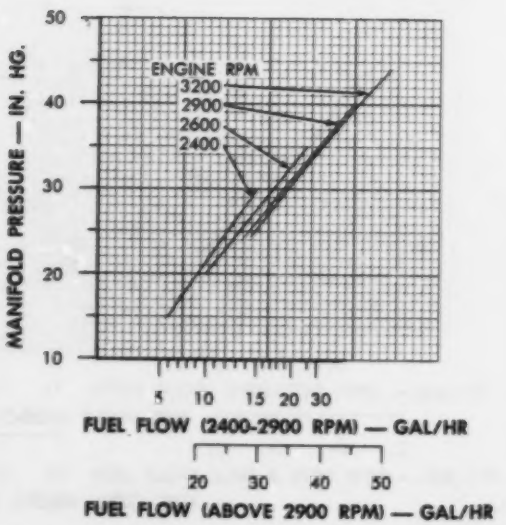
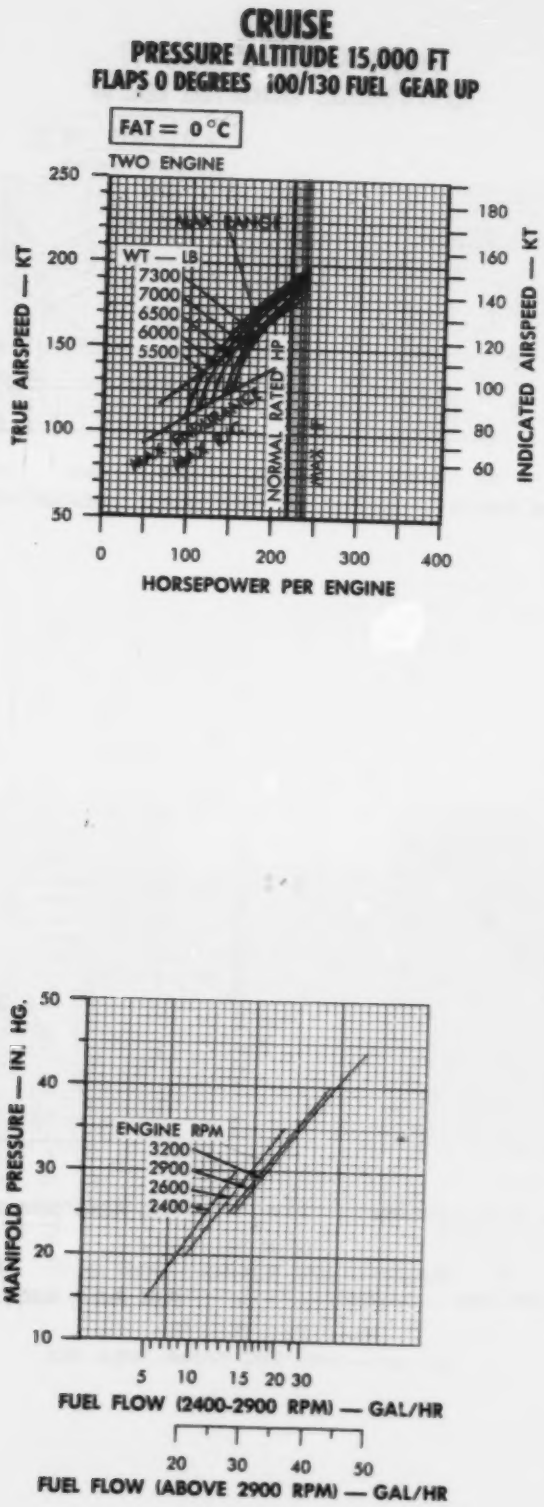


Figure 7-32. Cruise FAT −40° and −20°C, 15,000 Feet (U-8D, U-8G)

AP 001988

BLUE
RED

CRUISE
U-8D, U-8G
O-480-1



AP 001957

Figure 7-33. Cruise FAT 0°C, 15,000 Feet (U-8D, U-8G)

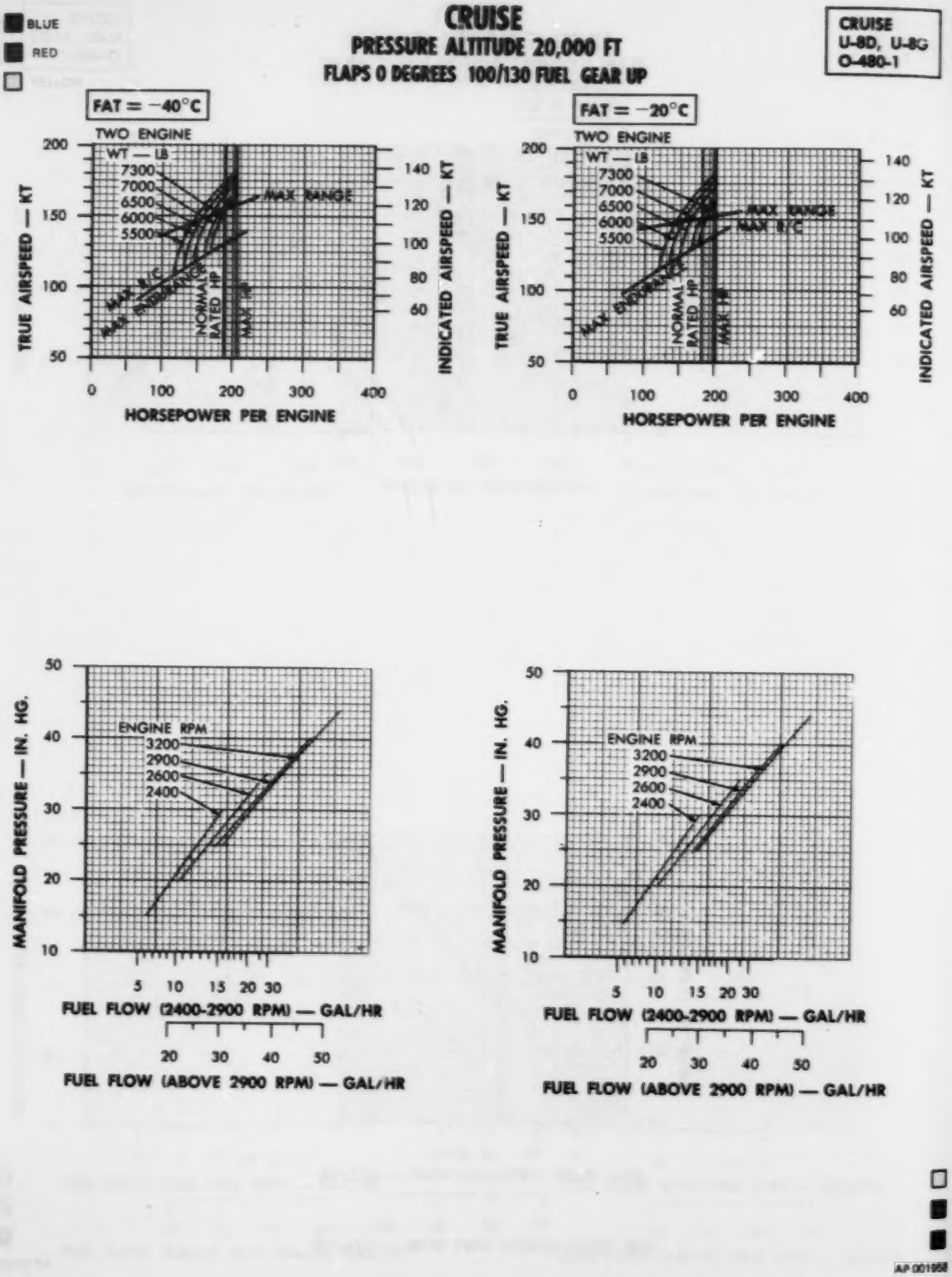
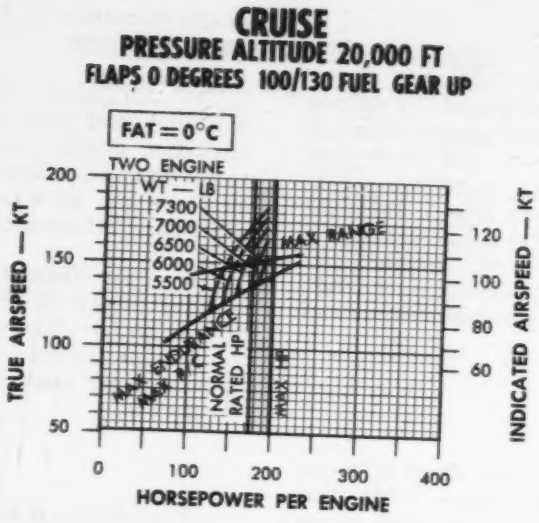
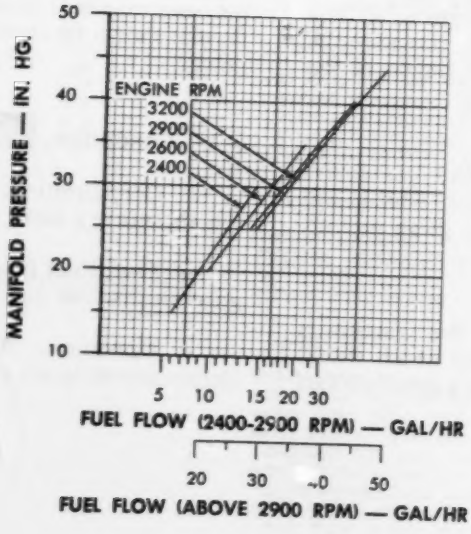


Figure 7-34. Cruise FAT −40° and −20°C, 20,000 Feet (U-8D, U-8G)

BLUE
RED

CRUISE
U-8D, U-8G
O-480-1





AP 001959

Figure 7-35. Cruise FAT 0°C, 20,000 Feet (U-8D, U-8G)

7-75. Description. RU - 8D

The Cruise Charts (figure 7-36 thru figure 7-46) show the horsepower per engine for various airspeeds and weights at selected combinations of altitude and temperature. Cruise and climb fuel flows are shown corresponding to engine power. Maximum performance lines are shown. Manifold pressure variation with propeller speed and engine horsepower are shown. Two engine and single-engine data are presented on the chart. Each individual chart is for a single pressure altitude and FAT.

7-76. Use of Chart. RU - 8D

The primary use of the Cruise Chart is shown in the Cruise Example Chart (figure 7-36). The Cruise Charts are for use in determining power settings to obtain a desired level of performance for a known set of conditions of altitude, temperature, weight and number of operating engines. Normally, sufficient accuracy can be obtained by selecting the chart nearest to the planned cruising altitude and temperature. If greater accuracy is desired, interpolation between two or more charts should be used. The power setting is obtained by adjusting manifold pressure, propeller speed, and fuel flow to values indicated on the chart.

a. Maximum Range. The maximum range line shows the airspeed which will provide the maximum range for a given aircraft weight at the chart conditions.

b. Maximum Endurance. The maximum endurance line shows the airspeed which will provide maximum endurance for a given aircraft weight at the chart conditions.

c. Maximum Rate-of-Climb. The maximum rate-of-climb line shows the airspeed which would provide maximum rate-of-climb for a given aircraft weight if maximum horsepower was used at the chart conditions.

d. Airspeed. The relationship between indicated and true airspeed is shown for the specific chart conditions of altitude and temperature. Conversion between the two airspeeds can be accomplished without regard to other chart information.

e. Fuel Flow. The fuel flow for cruise and climb settings is shown. Horsepower can be equated directly to fuel flow without regard to other chart information. To convert fuel flow to gallons per hour or pounds per hour refer to the Fuel Flow Chart (figure 7-9).

NOTE

Fuel flow values should be doubled for two engine operation.

f. Horsepower Per Engine. Horsepower per engine, although not readable in the cockpit is utilized in conjunction with the Climb/Descent Chart (figure 7-48) to obtain rate-of-climb or descent. The maximum horsepower line represents the horsepower which can normally be expected for operation at 3400 RPM and full throttle, and is not considered limiting.

g. Manifold Pressure. The relationship between manifold pressure, engine speed, and fuel flow is shown to enable the pilot to set the desired power.

7-77. Conditions. RU - 8D

a. Configuration. All cruise data are based on the aircraft in a clean configuration.

b. Fuel. Fuel flow is based on use of aviation gasoline 100/130.

c. Operation. Areas not recommended for cruise operation are shown in yellow.

GREEN
BLUE
RED

CRUISE
PRESSURE ALTITUDE 12,000 FT EXAMPLE
FLAPS 0 DEGREES 100/130 FUEL GEAR UP

CRUISE
RU-8D
O-480-1

EXAMPLE XIII-4

WANTED

TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER PER ENGINE AND MANIFOLD PRESSURE PER ENGINE FOR MAX RANGE CRUISE

KNOWN

WEIGHT = 6250 LB
PRESSURE ALTITUDE = 12,000 FT
FAT = 0°C
ENGINE RPM = 2400

METHOD 1 (SIMPLEST)

USE CHART FOR NEXT HIGHER CONDITION (15,000 FT)
ENTER MAX RANGE HERE
MOVE RIGHT AND UP TO WEIGHT = 6250 LB
MOVE LEFT, READ TRUE AIRSPEED = 129 KT
MOVE RIGHT, READ INDICATED AIRSPEED = 100 KT
MOVE DOWN, READ HORSEPOWER PER ENGINE = 117 HP
MOVE DOWN, READ FUEL FLOW PER ENGINE = 9 GAL/HR PER ENGINE
MOVE LEFT FROM ENGINE RPM, READ MANIFOLD PRESSURE PER ENGINE = 21 IN. HG.

METHOD 2 (INTERPOLATE)

READ TRUE AIRSPEED, INDICATED AIRSPEED, HORSEPOWER FUEL FLOW AND TORQUE AT EACH ADJACENT ALTITUDE AND OAT — THEN INTERPOLATE

ALTITUDE	10,000 FT	15,000 FT	12,000 FT
FAT	0°C	0°C	0°C
TRUE AIRSPEED	108	129	116
INDICATED AIRSPEED	91	100	95
HORSEPOWER	100	117	107
FUEL FLOW	7.5	9.0	8.1
MANIFOLD PRESSURE	18.7	21.0	19.6

EXAMPLE XIII-5

WANTED

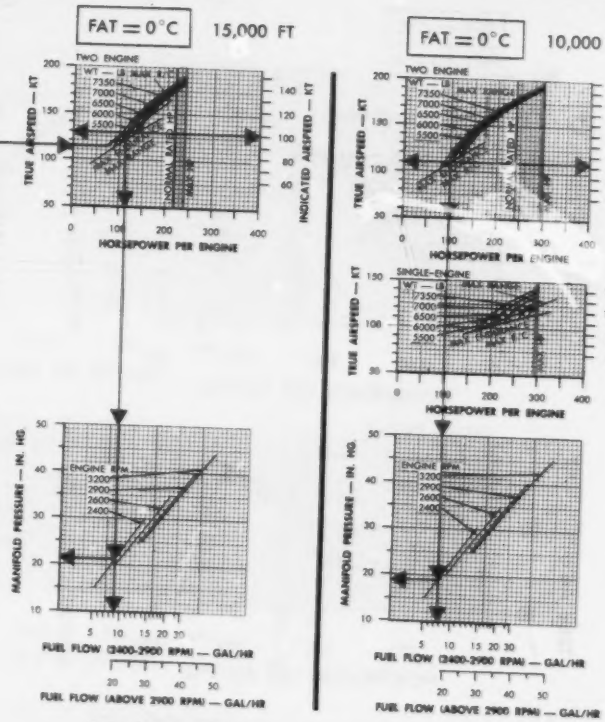
INDICATED AIRSPEED, HORSEPOWER PER ENGINE, FUEL FLOW AND MANIFOLD PRESSURE FOR A DESIRED TRUE AIRSPEED

KNOWN

DESIRED TRUE AIRSPEED = 150 KT
WEIGHT = 6250 LB
PRESSURE ALTITUDE = 15,000 FT
FAT = 0°C
ENGINE RPM = 2400

METHOD

ENTER TRUE AIRSPEED ON LEFT
MOVE RIGHT TO INDICATED AIRSPEED = 116 KT
MOVE DOWN FROM WEIGHT, READ HORSEPOWER = 148 HP
MOVE DOWN, READ FUEL FLOW = 11.5 GAL/HR PER ENGINE
MOVE LEFT FROM ENGINE RPM, READ MANIFOLD PRESSURE = 25.5 IN. HG.



EXAMPLE XIII-6

WANTED

MAX RATE-OF-CLIMB, INDICATED AIRSPEED, HORSEPOWER PER ENGINE FOR LEVEL FLIGHT AT MAX R/C AIRSPEED, MAX CONT HORSEPOWER AVAILABLE, EXCESS HORSEPOWER AVAILABLE FOR CLIMB, FUEL FLOW AND MANIFOLD PRESSURE FOR MAX CLIMB

KNOWN

WEIGHT = 6250 LB
PRESSURE ALTITUDE = 15,000 FT
FAT = 0°C
ENGINE SPEED = 2400

METHOD

ENTER CHART AT MAX R/C LINE
MOVE RIGHT AND UP TO WEIGHT = 6250
MOVE RIGHT, READ MAX R/C INDICATED AIRSPEED = 91 KT
MOVE DOWN FROM WEIGHT LINE, READ HORSEPOWER REQUIRED FOR LEVEL FLIGHT AT MAX R/C AIRSPEED = 108 HP
MOVE DOWN FROM MAX CONT HP LINE, READ MAX CONT HORSEPOWER AVAILABLE = 238 HP
MOVE DOWN FROM MAX CONT HP AVAILABLE, READ CLIMB FUEL FLOW = 36.5 GAL/HR PER ENGINE (3200 RPM)
MOVE LEFT FROM ENGINE RPM LINE, READ MANIFOLD PRESSURE TO SET FOR CLIMB = 33.0 IN. HG. (3200 RPM)
DETERMINE EXCESS HORSEPOWER PER ENGINE AVAILABLE FOR CLIMB — MAX CONT HORSEPOWER AVAILABLE LESS HORSEPOWER REQUIRED FOR LEVEL FLIGHT = 238—108 = 130 HP PER ENGINE

AP 002079

Figure 7-36. Cruise Example (RU-8D)

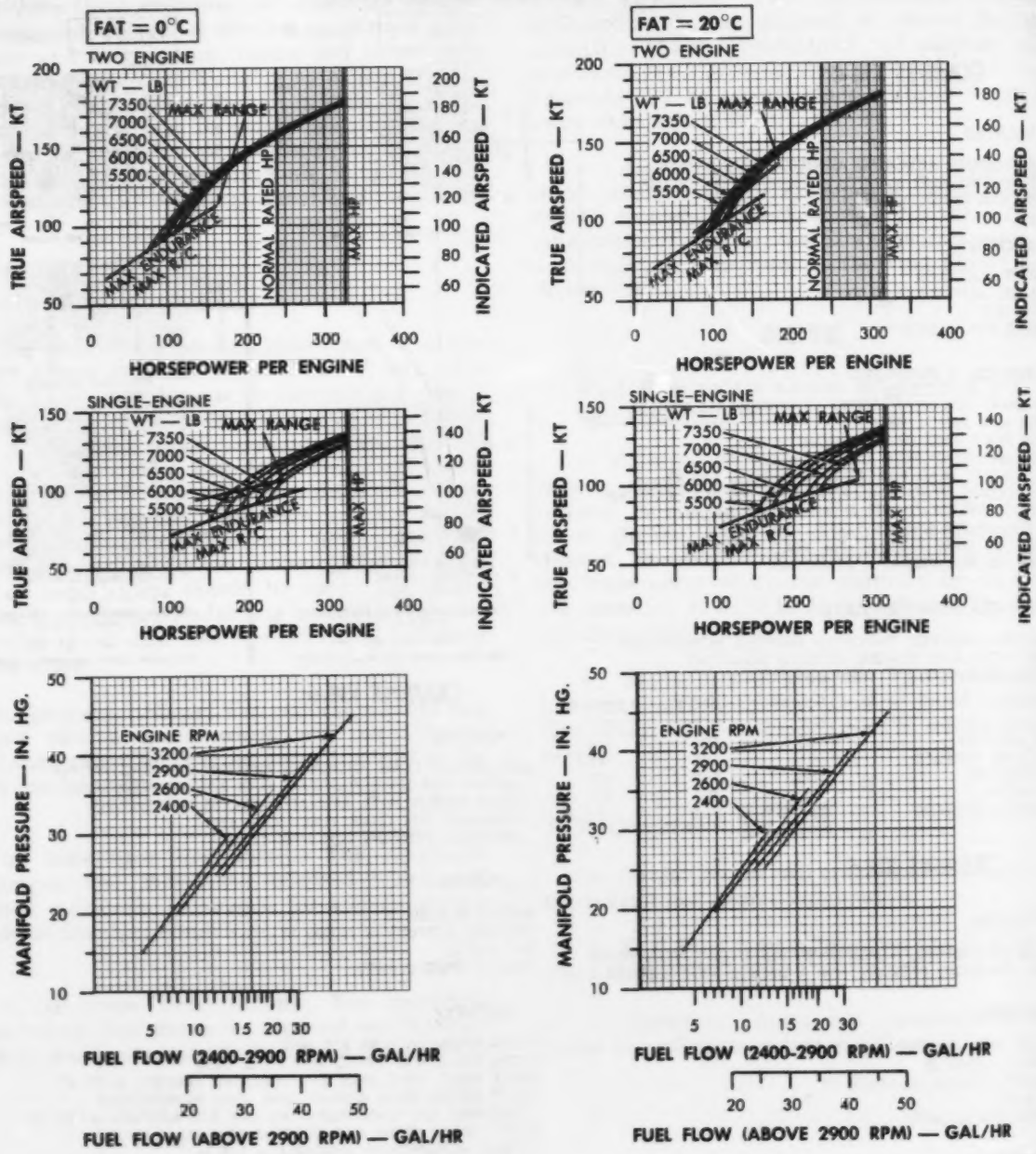
BLUE
RED

CRUISE

PRESSURE ALTITUDE SEA LEVEL

FLAPS 0 DEGREES 100/130 FUEL GEAR UP

CRUISE
RU-8D
O-480-1

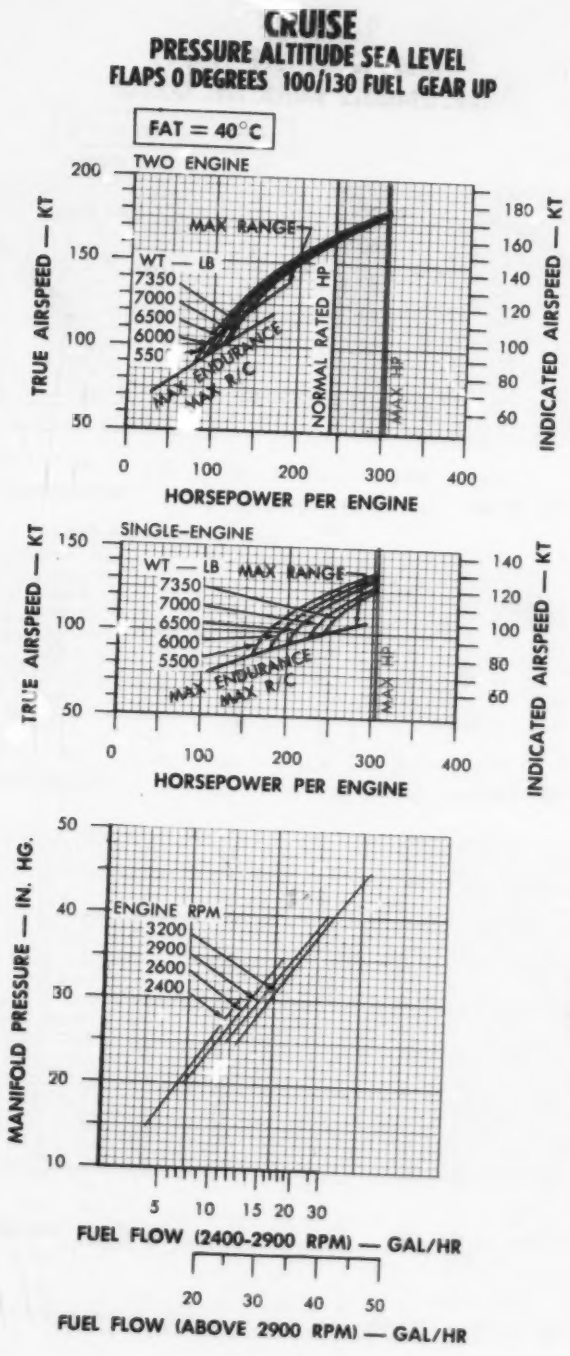


AP 002063

Figure 7-37. Cruise FAT 0° and 20°C, Sea Level (RU-8D)

BLUE
RED

CRUISE
RU-8D
O-480-1



AP 002064

Figure 7-38. Cruise FAT 40°C, Sea Level (RU-8D)

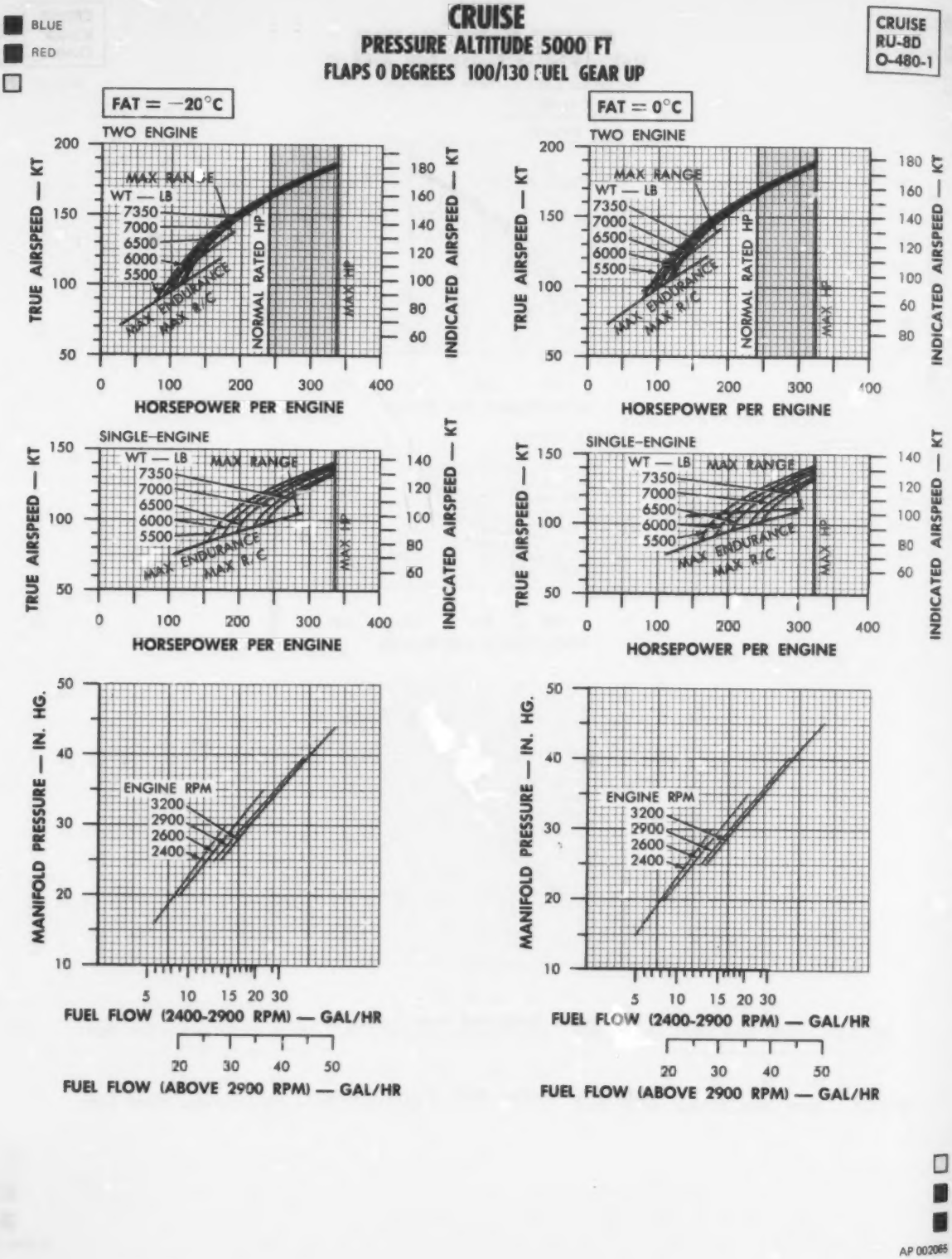
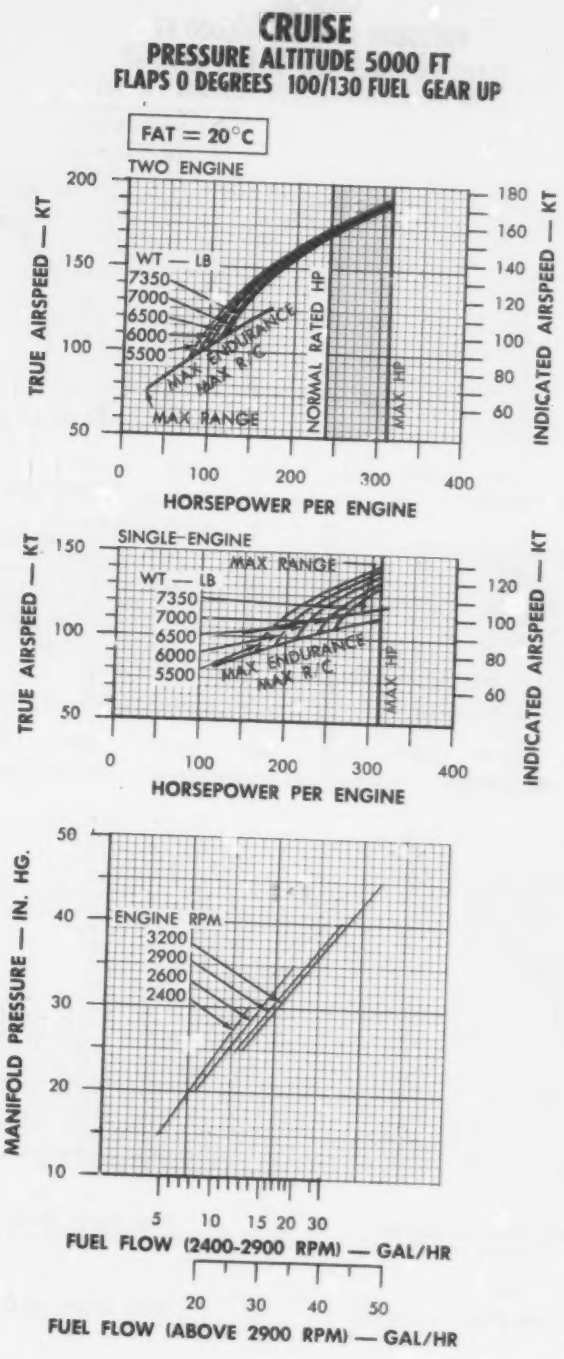


Figure 7-39. Cruise FAT −20° and 0°C, 5000 Feet (RU-8D)

BLUE
RED

CRUISE
RU-8D
O-480-1



AP 002066

Figure 7-40. Cruise FAT 20°C, 5000 FT (RU-8D)

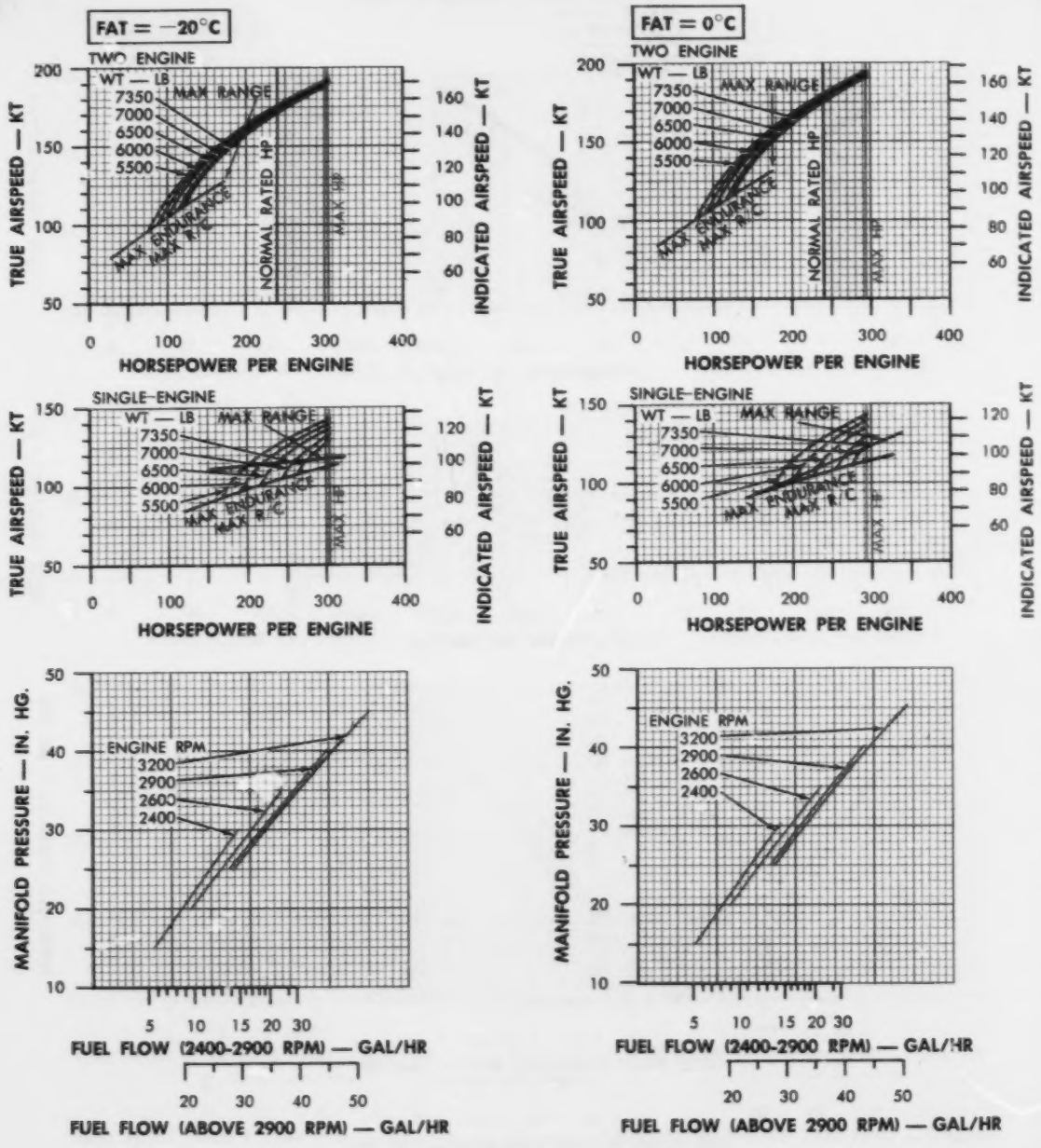
CRUISE

PRESSURE ALTITUDE 10,000 FT

FLAPS 0 DEGREES 100/130 FUEL GEAR UP

BLUE
RED

CRUISE
RU-8D
O-480-1



AP 002067

Figure 7-41. Cruise FAT −20° and 0°C, 10,000 Feet (RU-8D)

BLUE
RED

CRUISE
RU-8D
O-480-1

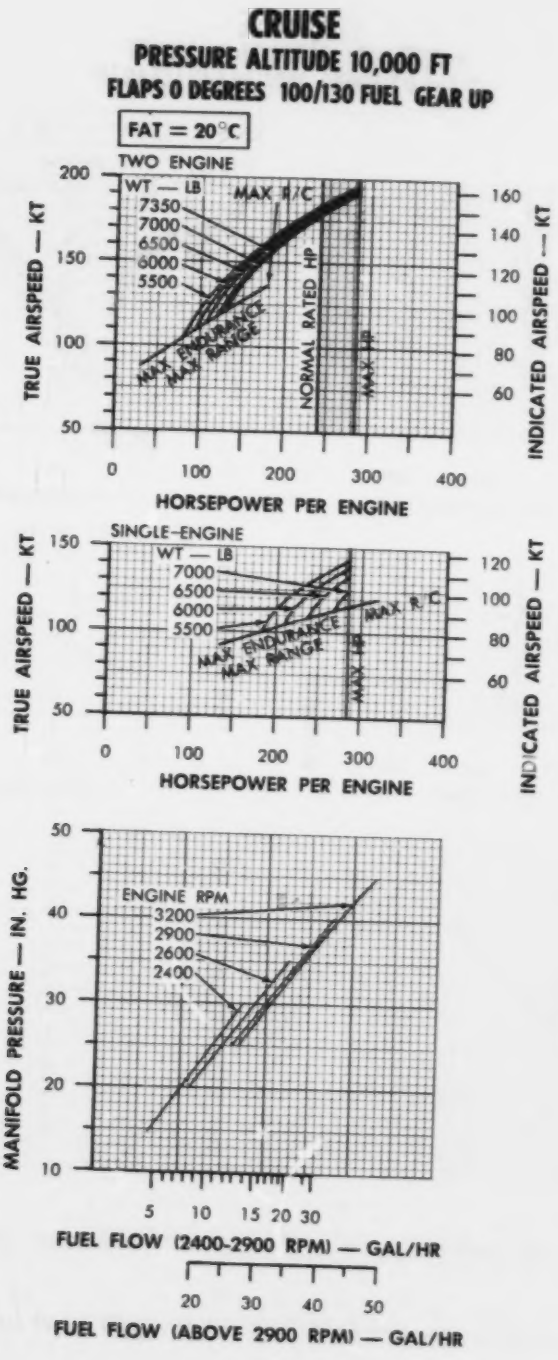


Figure 7-42. Cruise FAT 20°C, 10,000 Feet (RU-8D)

AP 002068

BLUE
RED

CRUISE
PRESSURE ALTITUDE 15,000 FT
FLAPS 0 DEGREES 100/130 FUEL GEAR UP

CRUISE
RU-8D
O-480-1

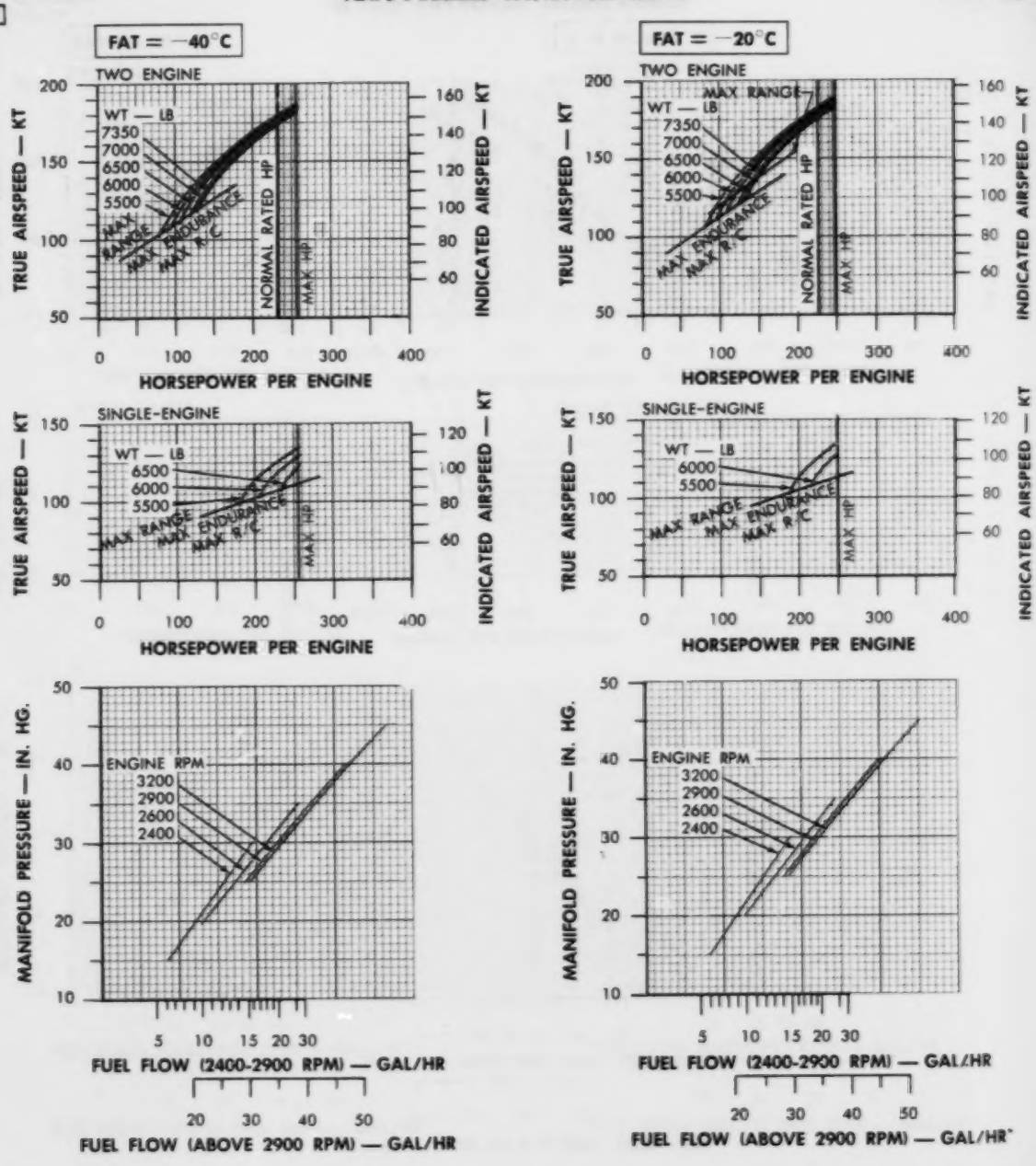
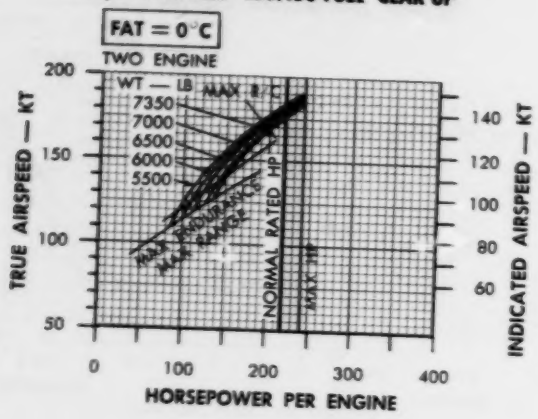


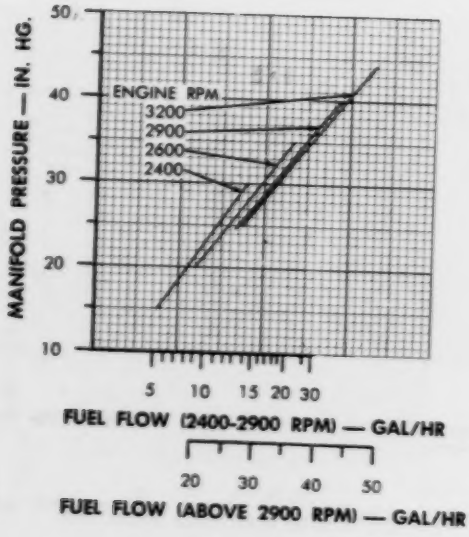
Figure 7-43. Cruise FAT −40° and −20°C, 15,000 Feet (RU-8D)

BLUE
RED

CRUISE
RU-8D
O-480-1

CRUISE
PRESSURE ALTITUDE 15,000 FT
FLAPS 0 DEGREES 100/130 FUEL GEAR UP





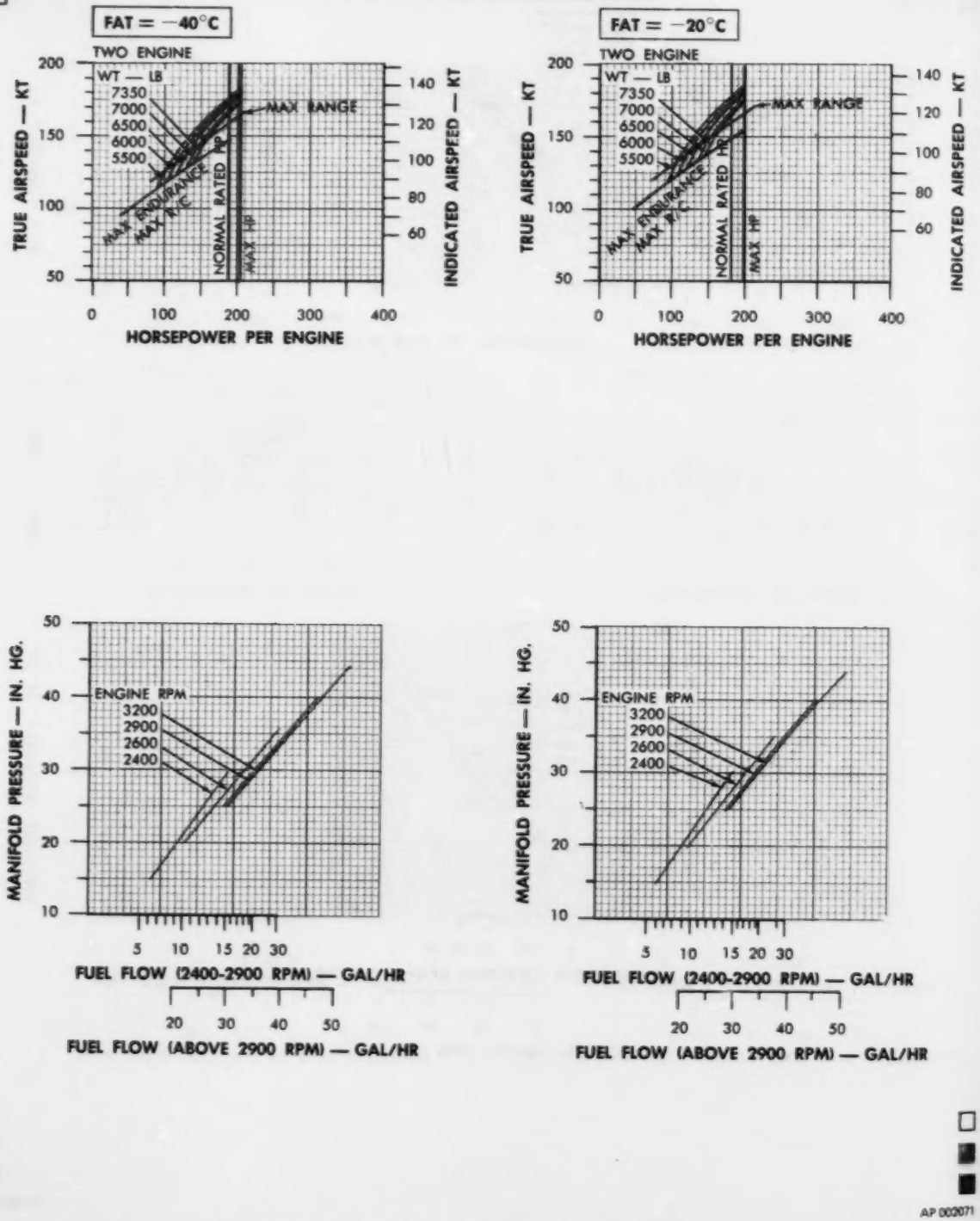
AP 002070

Figure 7-44. Cruise FAT 0°C, 15,000 Feet (RU-8D)

BLUE
RED

CRUISE
PRESSURE ALTITUDE 20,000 FT
FLAPS 0 DEGREES 100/130 FUEL GEAR UP

CRUISE
RU-8D
O-480-1

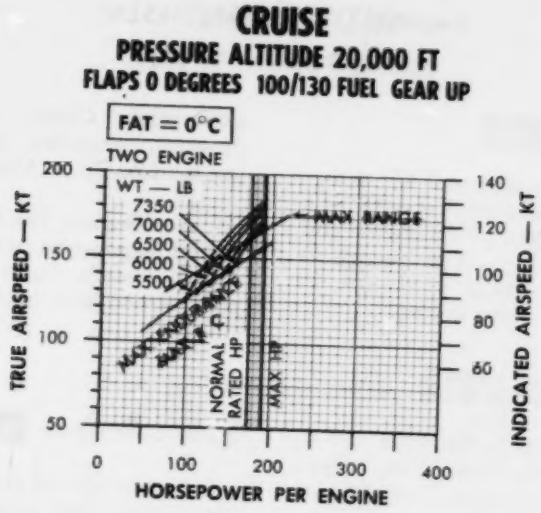


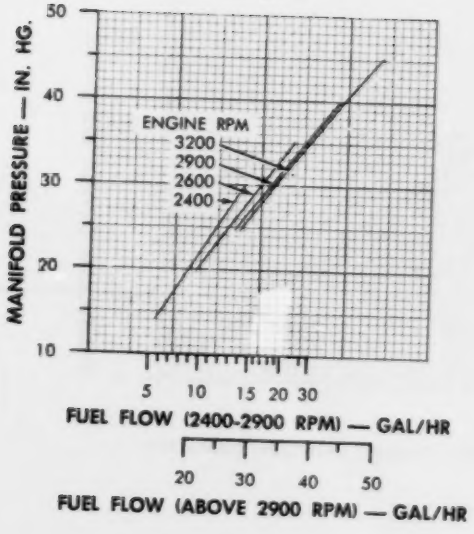
AP 002071

Figure 7-45. Cruise FAT −40° and −20°C, 20,000 Feet (RU-8D)

BLUE
RED

CRUISE
RU-8D
O-480-1





AP 002072

Figure 7-46. Cruise FAT 0°C, 20,000 Feet (RU-8D)

Section XIV. CLIMB/DESENT

7-78. Description. U-8D U-8G

The Climb/Descent Chart (figure 7-47) shows the rate-of-climb or descent at a given weight for a change in horsepower per engine. Two-engine and single-engine operation is shown. The change in manifold pressure to obtain a change in horsepower at constant RPM is also shown.

7-79. Use of the Chart. U-8D U-8G

Use of the chart is shown by Example XIV-1. The horsepower per engine required for level flight is obtained from the appropriate Cruise Chart (figure 7-25 thru 7-35).

a. Climb. The horsepower change per negine is that additional power needed to obtain the desired rate-of-climb at a known weight. The excess horsepower available is obtained from the appropriate Cruise Chart. Determine manifold pressure, propeller speed, and fuel flow from appropriate Cruise Chart (figure 7-25 thru 7-35).

b. Descent. The horsepower change per engine is that decrease in power needed to obtain a desired rate-of-descent. Determine manifold pressure, propeller speed, and fuel flow from appropriate cruise chart.

7-80. Conditions. U-8D U-8G

a. Changes in power due to manifold pressure change only can be obtained as shown by Example XIV-2.

b. Rate-of-climb/descent will change as altitude and temperature change. Re-evaluate as altitude and temperature change.

GREEN

CLIMB/DESCENT

GEAR UP FLAPS 0 DEGREES

CLIMB/DESCENT
U-8D, U-8G
O-480-1

EXAMPLE XIV-1

WANTED

RATE OF CLIMB OR DESCENT AS A RESULT OF CHANGE IN HORSEPOWER

KNOWN

HORSEPOWER CHANGE = 50 HP
WEIGHT = 6400 LB

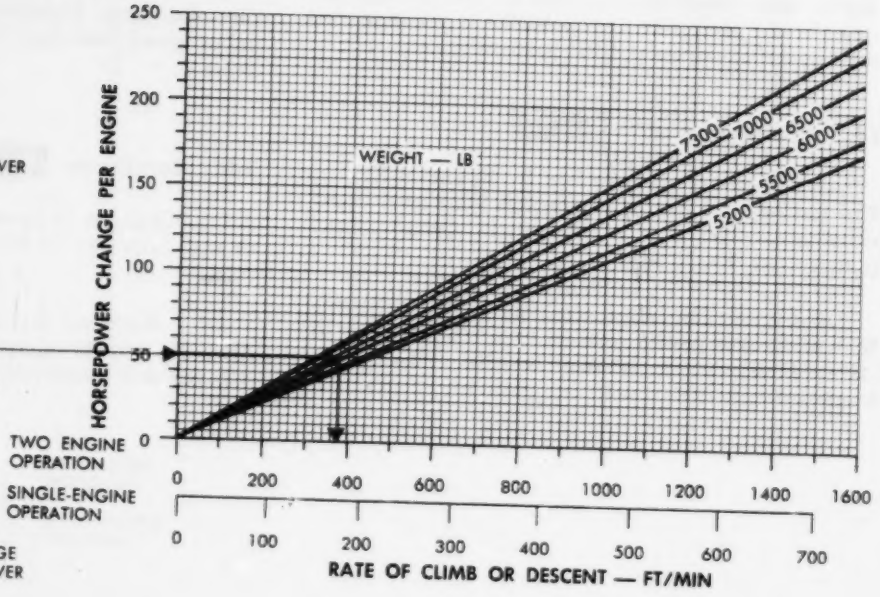
METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO WEIGHT
MOVE DOWN, READ RATE OF CLIMB = 375 FT/MIN

NOTE

FOR CLIMB, THE HORSEPOWER CHANGE PER ENGINE IS THE CLIMB HORSEPOWER AVAILABLE DETERMINED FROM CRUISE CHARTS

DATA BASIS: ESTIMATED



EXAMPLE XIV-2

WANTED

MANIFOLD PRESSURE CHANGE AS A RESULT OF CHANGE IN HORSEPOWER AT A GIVEN RPM

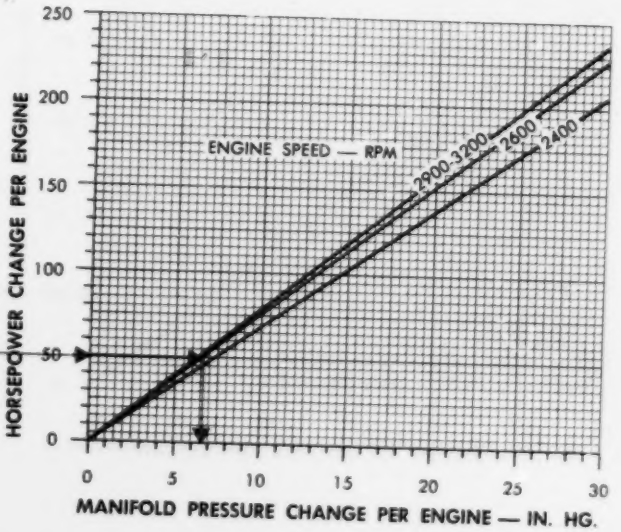
KNOWN

HORSEPOWER CHANGE = 50 HP
ENGINE SPEED = 2600 RPM

METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO RPM
MOVE DOWN, READ MANIFOLD PRESSURE CHANGE = 6.6 IN. HG.

DATA BASIS: CALCULATED



AP 001970

Figure 7-47. Climb/Descent (U-8D, U-8G)

7-81. Description. RU - 8D

The Climb/Descent Chart (figure 7-48) shows the rate-of-climb or descent at a given weight for a change in horsepower per engine. Two-engine and single-engine operation is shown. The change in manifold pressure to obtain a change in horsepower at constant RPM is also shown.

7-82. Use of the Chart. RU - 8D

Use of the chart is shown by Example XIV-3. The horsepower per engine required for level flight is obtained from the appropriate Cruise Chart (figure 7-36 thru 7-46).

a. Climb. The horsepower change per engine is that additional power needed to obtain the desired rate-of-climb at a known weight. The excess horsepower available is obtained from the appropriate Cruise Chart. Determine manifold pressure, propeller speed, and fuel flow from appropriate Cruise Chart (figure 7-36 thru 7-46).

b. Descent. The horsepower change per engine is that decrease in power needed to obtain a desired rate-of-descent. Determine manifold pressure, propeller speed, and fuel flow from appropriate cruise chart.

7-83. Conditions. RU - 8D

a. Changes in power due to manifold pressure change only can be obtained as shown by Example XIV-4.

b. Rate-of-climb/descent will change as altitude and temperature change. Re-evaluate as altitude and temperature change.

GREEN

CLIMB/DESCENT

GEAR UP FLAPS 0 DEGREES

CLIMB/DESCENT
RU-8D
O-480-1

EXAMPLE XIV-3

WANTED

RATE-OF-CLIMB OR DESCENT AS A RESULT OF CHANGE IN HORSEPOWER

KNOWN

HORSEPOWER CHANGE = 50 HP
WEIGHT = 6400 LB

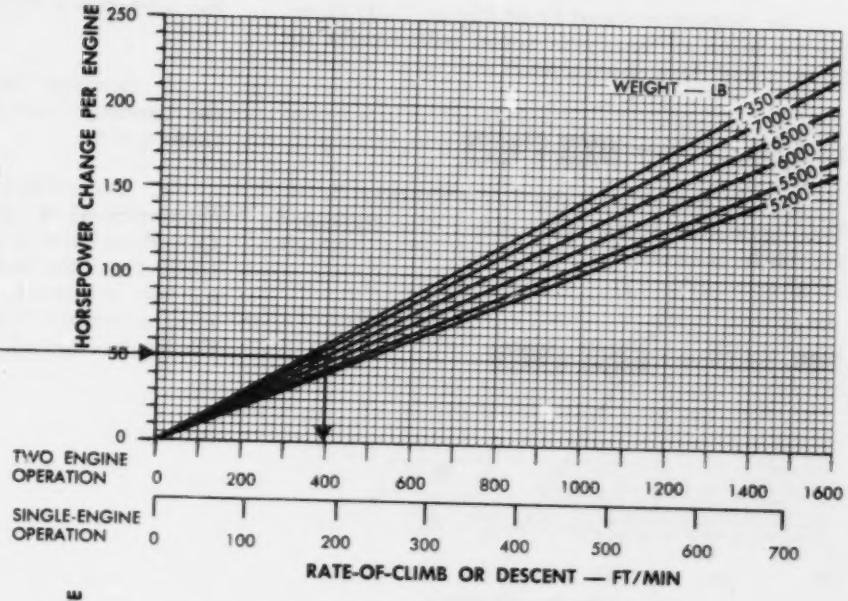
METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO WEIGHT
MOVE DOWN, READ RATE OF CLIMB = 400 FT/MIN

NOTE

FOR CLIMB THE HORSEPOWER CHANGE PER ENGINE IS THE CLIMB HORSEPOWER AVAILABLE DETERMINED FROM CRUISE CHARTS.

DATA BASIS: ESTIMATED



EXAMPLE XIV-4

WANTED

MANIFOLD PRESSURE CHANGE AS A RESULT OF CHANGE IN HORSEPOWER AT A GIVEN RPM

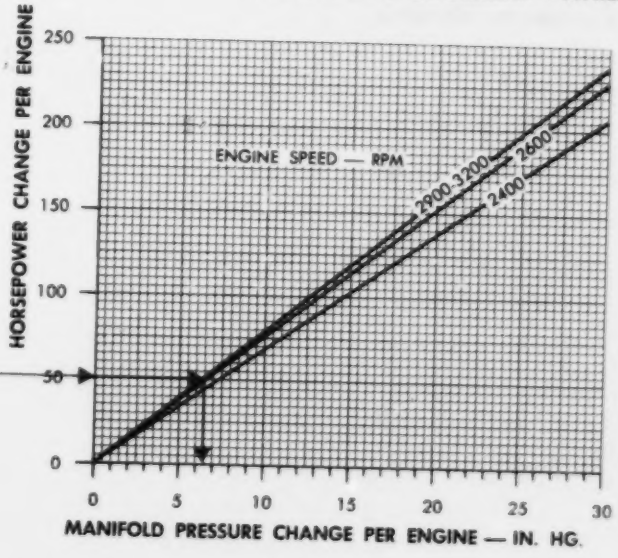
KNOWN

HORSEPOWER CHANGE = 50 HP
ENGINE SPEED = 2600 RPM

METHOD

ENTER HORSEPOWER CHANGE HERE
MOVE RIGHT TO RPM
MOVE DOWN, READ MANIFOLD PRESSURE CHANGE = 6.6 IN. HG.

DATA BASIS: CALCULATED



AP 001903

Figure 7-48. Climb/Descent (RU-8D)

Section XV. APPROACH SPEED

7-84. Description. U-8D U-8G

The Approach Speed Chart (figure 7-49) shows the variation of approach speed with weight for flaps up and flaps down operation.

7-85. Use of Chart. U-8D U-8G

Use of the chart is shown by Example XV-1. The approach speed line shows the indicated approach airspeed to use for a given aircraft weight.

7-86. Condition. U-8D, U-8G

a. Speeds. These speeds have been selected to provide adequate margins above the stall speeds for the appropriate flap settings.

b. Landing Chart. Performance scheduled on the Landing Chart (figure 7-51) is based on use of these speeds.

c. Touchdown. The touchdown shall be accomplished at speeds less than those scheduled. Consideration shall be given to the appropriate stall speed from the Stall Speed Chart (figure 8-2) and to the minimum touchdown speed needed to remain within the recommended area on the Crosswind-Takeoff or Landing Chart (figure 7-7).

GREEN

APPROACH SPEED
GEAR DOWN

APPROACH SPEED
U-3D, U-8G
O-480-1

EXAMPLE XV-1

WANTED

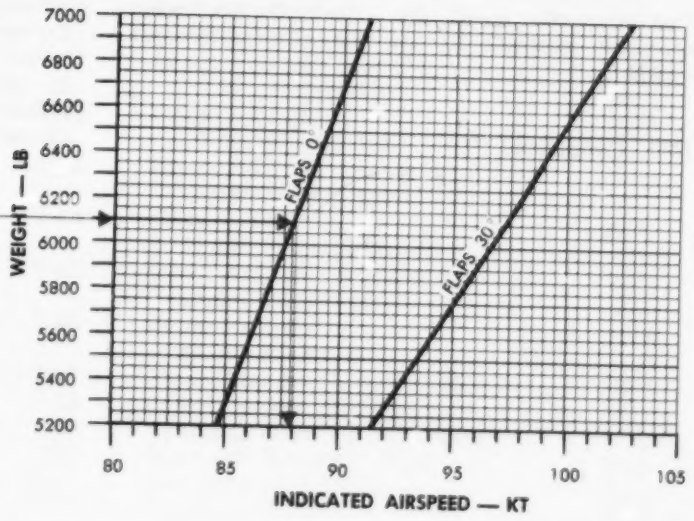
RECOMMENDED APPROACH SPEED FOR KNOWN WEIGHT

KNOWN

WEIGHT = 6110 LB
FLAP SETTING = 0°

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN, READ APPROACH SPEED = 88 KT



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001964

Figure 7-49. Approach Speed (U-8D, U-8G)

7-87. Description.

The Approach Speed Chart (figure 7-49) shows the variation of approach speed with weight for flaps up and flaps down operation.

7-88. Use of Chart.

Use of the chart is shown in Example XV-1. The approach speed line shows the indicated approach airspeed to use for a given aircraft weight.

7-89. Condition.

a. Speeds. These speeds have been selected to provide adequate margins above the stall speeds for the appropriate flap settings.

b. Landing Chart. Performance scheduled on the Landing Chart (figure 7-52) is based on use of these speeds.

c. Touchdown. The touchdown shall be accomplished at speeds less than those scheduled. Consideration shall be given to the appropriate stall speed from the Stall Speed Chart (figure 8-3) and to the minimum touchdown speed needed to remain within the recommended area on the Crosswind-Takeoff or Landing Chart (figure 7-8).

SECTION	TITLE	FIGURE NO.	CHART SUBJECT	PAGE NO.
		7-36	Cruise Example (RU-8D)	7-63
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		7-48	Climb/Descent (RU-8D)	7-77
XV	Approach Speed	7-49	Approach Speed (U-8D, U-8G)	7-79
		7-50	Approach Speed (RU-8D)	7-81
XVI	Landing	7-51	Landing (U-8D, U-8G)	7-83
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7-7. Color Coding.

The performance charts are color coded as follows:

a. Green: Example guidelines.

b. Red: Limit lines.

c. Yellow: Precautionary or time-limited operation.

d. Blue: Maximum performance conditions.

7-8. Reading The Charts.

The primary use of each chart is given in an example and a green guideline is provided to help you follow the route through the chart. The use of a straight edge (ruler or page edge) and a hard fine point pencil is recommended to avoid cumulative errors. The majority of the charts provide a standard pattern for use as follows: enter first variable on top left scale, move right to the second variable, reflect down at right angles to the third variable, reflect left at right angles to the fourth variable, reflect down, etc. until the final variable is read out at the final scale. In addition to the primary use, other uses of each chart are explained in the text accompanying each set of performance charts. Colored registration blocks located on the bottom and top of each chart are used to determine if slippage has occured during printing. If slippage has occured, refer to Chapter 5 for correct operating limits.

7-9. Dashed Line Data.

Data beyond conditions for which tests were conducted are shown as dashed lines.

7-10. Data Basis.

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The applicable report and date of the data are also given. The data provided generally is based on one of four categories:

a. Flight Test Data. Data obtained by flight test of the aircraft by experienced flight test

personnel at precise conditions using sensitive calibrated instruments.

b. Derived From Flight Test. Flight test data obtained on a similar rather than the same aircraft and series. Generally small corrections have been made.

c. Calculated Data. Data based on tests, but not on flight test of the complete aircraft.

d. Estimated Data. Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7-11. Specific Conditions.

The data presented is accurate only for specific conditions listed under the title of each chart. Variables for which data is not presented, but which may affect that phase of performance, are discussed in the text. Where data is available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7-12. General Conditions.

The following general conditions might have deteriorating effects on the aircraft performance: atmospheric humidity, fuel flow, rigging, pilot technique, aircraft variation, engine variation, and instrument variation.

7-13. Performance Discrepancies.

Regular use of this chapter will allow you to monitor instrument and other aircraft systems for malfunction, by comparing actual performance with planned performance. Knowledge will also be gained concerning the effects of variables for which data is not provided, thereby increasing the accuracy of performance predictions.

7-14. Definitions of Abbreviations.

Abbreviations used through this chapter are defined as follows:

IAS	Indicated airspeed assuming zero instrument error.
CAS	Calibrated airspeed; IAS corrected for position error.
TAS	True airspeed; CAS corrected for compressability and relative density.
Vmc	Minimum control speed; the speed sufficient to enable the aircraft to maintain a heading: takeoff configuration, dead engine propeller windmilling, with maximum power and 5 degrees bank into live engine.
KT	Knots.
FT	Feet.
NM	Nautical miles.
NAUT	Nautical.
TEMP	Temperature.
FAT	Free air temperature.
°C	Degrees celsius.
°F	Degrees fahrenheit.
RPM	Revolutions per minute.
LB	Pounds.
DEG	Degrees.
in. Hg.	Inches mercury.
HP	Horsepower.
GAL	Gallons.
PSI	Pounds per square inch.
R/C	Rate-of-climb.
SL	Sea Level.
PRESS ALT	Pressure Altitude.
FT/MIN	Feet per minute.
MIN	Minutes.
HR	Hours.
MAX	Maximum.
DN	Down.

CHAPTER 7

PERFORMANCE DATA

Section I. INTRODUCTION

7-1. Description.

The charts presented in this chapter are based on and are consistent with the recommended operating procedures and techniques set forth in other chapters of this manual. The charts contain the performance data necessary for preflight and inflight mission planning. Explanatory text applicable to each type of chart is included to illustrate the use of the data presented.

7-2. Purpose.

a. The purpose of this chapter is to provide the best available performance data for the U-8D, U-8G and RU-8D aircraft. Regular use of this information will enable you to receive maximum safe utilization from the aircraft. Although maximum performance is not always required, regular use of this chapter is recommended for the following reasons:

(1) Knowledge of your performance margin will allow you to make better decisions when unexpected conditions or alternate missions are encountered.

(2) Situations requiring maximum performance will be more readily recognized.

(3) Familiarity with the data will allow performance to be computed more easily and quickly.

(4) Experience will be gained in accurately estimating the effects of variables for which data are not presented.

b. The information is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The data may also be used in flight, to establish unit or area standing operating procedures, and to inform ground commanders of performance/risk tradeoffs.

7-3. General.

The data presented shall cover the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, your judgement and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text accompanying each phase of performance. Where practical, data are presented at conservative conditions. However, **NO GENERAL CONSERVATISM HAS BEEN APPLIED.** All performance data presented are within the applicable limits of the aircraft.

CAUTION

Exceeding operating limits can cause permanent damage to critical components. Overlimit operation can decrease performance, cause immediate failure, or failure on a subsequent flight.

7-4. Limits.

Applicable limits are shown on the charts as red lines. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum value and time above limits on DA Form 2408-13 so proper maintenance action can be taken.

7-5. Chart Explanation.

A complete series of performance charts are provided for U-8D, U-8G and RU-8D aircraft in this manual. These charts furnish the pilot with sufficient data to make an intelligent and safe flight plan. The charts include data on takeoff, climb, landing, and operating instructions for cruising flight from maximum endurance to normal rated power. No allowance has been made for navigational error, formation flight, or other contingencies. Appropriate allowances for these items should be dictated by local regulations and should be accounted for when the fuel available for cruise is determined. The charts are arranged to give maximum facility of use in preflight and inflight planning. All charts are based on ambient temperature conditions and pressure altitude.

7-6. Chapter 7 Index.

SECTION	TITLE	FIGURE NO.	CHART SUBJECT	PAGE NO.
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II	Performance Planning	7-1	Performance Planning Card	7-6
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		7-3	Airspeed Calibration (U-8D, U-8G)	7-10
		7-4	Airspeed Calibration (RU-8D)	7-11
		7-5	Altimeter Correction (U-8D, U-8G)	7-12
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		7-27	Cruise FAT 40° C SL (U-8D, U-8G)	7-53
		7-28	Cruise FAT -20° and 0° C, 5000 Ft (U-8D, U-8G)	7-54
		7-29	Cruise FAT 20° C, 5000 Ft (U-8D, U-8G)	7-55
		7-30	Cruise FAT -20° and 0° C, 10,000 Ft (U-8D, U-8G)	7-56
		7-31	Cruise FAT 20° C, 10,000 Ft (U-8D, U-8G)	7-57
		7-32	Cruise FAT -40° and -20° C, 15,000 Ft (U-8D, U-8G)	7-58
		7-33	Cruise FAT 0° C, 15,000 Ft (U-8D, U-8G)	7-59
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		7-35	Cruise FAT 0° C, 20,000 Ft (U-8D, U-8G)	7-61

(1) Pressure altitude.

(2) FAT.

2. Aircraft Conditions.

(1) Weight — Estimated from fuel flow and elapsed time. Refer to Fuel Flow Chart (figure 7-9) to obtain LB/HR conversion.

(2) Climb IAS — Desired climb speed if other than for maximum performance.

(2) Determine the following from the appropriate Cruise Charts (figure 7-25 thru 7-46). Use the two engine or single-engine graphs as required. (Interpolation between charts may be necessary.)

1. Max. R/C IAS.

2. Max. HP available.

3. Level Flight HP — At climb IAS or max R/C IAS, whichever is to be used for climb.

4. Climb HP available — Max HP available less level flight HP required.

5. Engine speed.

6. Climb fuel flow — At Max HP available (Gal/Hr).

(3) Determine the following from the performance charts indicated:

1. Fuel flow in LB/HR/ENG — From Fuel Flow Chart (figure 7-9). (For two engine operation, double the fuel flow per engine to obtain total fuel flow.)

2. Rate-of-Climb — From Climb/Descent Chart (Figure 7-47 or 7-48); horsepower change is the climb HP available determined above. (Use two engine or single-engine operation as necessary.)

c. Cruise Climb.

(1) Determine the following before entering the Cruise Climb Chart (figure 7-23 or 7-24):

1. Pressure altitude — Initial and final.

2. FAT — Initial and final corresponding to initial and final pressure altitudes.

3. Aircraft weight at beginning of cruise climb.

(2) Enter the Cruise Chart and determine:

1. Time — Difference between times for final and initial conditions.

2. Fuel — Difference between fuel required for final and initial conditions.

3. Distance — Difference between distance required for final and initial conditions.

d. Cruise.

(1) Determine the following before entering performance charts:

1. Atmospheric conditions for cruise.

(1) Pressure altitude.

(2) FAT.

2. Aircraft Conditions.

(1) Weight — Estimated average cruise weight (consider distance and estimated speed and fuel flow rate).

(2) Cruise airspeeds — If other than for maximum performance.

(2) Determine the following from the appropriate Cruise Charts (figure 7-25 thru 7-46). Use Two Engine or Single-Engine Charts as required. (Interpolation between charts may be necessary.)

1. Maximum performance airspeeds — If max performance is desired.

2. Level flight HP required — At the desired airspeed.

3. Engine speed.

4. Manifold pressure.

5. Cruise fuel flow — Refer to Fuel Flow Chart (figure 7-9) to obtain LB/HR and GAL/HR.

e. Arrival.

(1) Determine the following before entering performance charts:

TEMPERATURE/CONVERSION CORRECTION

GREEN

TEMPERATURE CONVERSION/CORRECTION
U-8D, U-8G, RU-8D
O-480-1

EXAMPLE II-1

WANTED

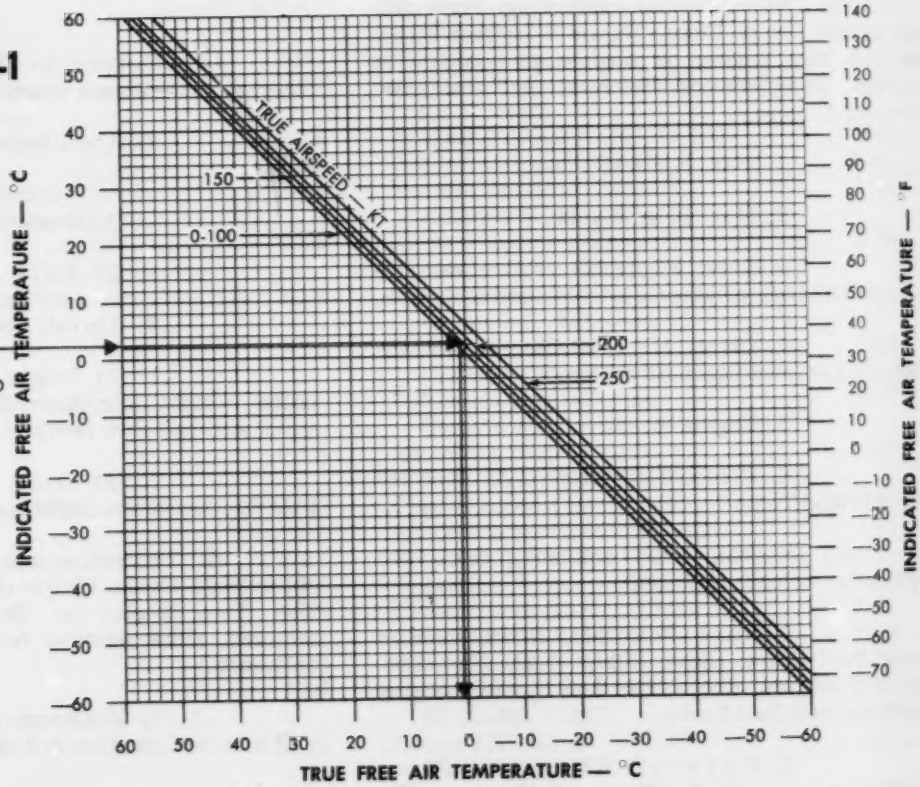
TRUE FAT

KNOWN

INDICATED FAT = 2.5°C
TRUE AIRSPEED = 154 KT

METHOD

ENTER INDICATED FAT HERE
MOVE RIGHT TO TRUE AIRSPEED MOVE DOWN TO READ TRUE FAT = 0.5°C



AP 001885

Figure 7-2. Temperature Conversion/Correction

Section II. PERFORMANCE PLANNING

7-15. Performance Planning Card.

This card (figure 7-1), is provided to assist the pilot in recording data applicable to the mission and may be reproduced at the local level. The data card provides readily available information for departure, climb, cruise climb, cruise, arrival, and prevailing conditions. Pertinent data required to fill in the blanks on the card shall be computed from the performance charts contained in this chapter, and from existing conditions at time of takeoff or landing. The takeoff and landing data shall be computed prior to takeoff, as a precaution against emergency conditions which could develop after takeoff.

7-16. Performance Planning Sequence.

Completion of the Performance Planning Card is accomplished as follows:

a. Departure.

(1) Determine the following before entering performance charts.

1. Atmospheric Conditions.

(1) Pressure Altitude. Pressure altitude is determined by setting the altimeter to 29.92 and reading pressure altitude, or by adding 100 feet to field elevation for each 0.1 in. Hg. below 29.92, or by subtracting 100 feet from field elevation for each 0.1 in. Hg. above 29.92.

(2) FAT.

(3) Wind (direction/speed).

2. Airport Conditions.

(1) Runway (direction/length/slope).

(2) Obstacles to be cleared (height/distance).

(2) Determine the following from the performance charts.

1. Aircraft Operating Conditions.

(1) Takeoff weight — Either estimated, or determined from the Single-Engine Climb Chart (positive R/C for gear down).

(2) Departure airspeeds — Vmc from the Minimum Single-Engine Control Airspeed Chart (figure 7-17 or 7-18). Rotation, takeoff and obstacle clearance airspeeds from the Normal Rotation/Takeoff Airspeed Chart (figure 7-13 or 7-14).

(3) Fuel flow and manifold pressure — From the Manifold Pressure Available for Takeoff Chart (figure 7-10).

2. Aircraft Performance.

(1) Takeoff distances — Ground roll and obstacle height distances from the Takeoff-Normal Chart (figure 7-11 or 7-12).

(2) Acceleration check — Speed corresponding to distance from the Acceleration Check Distance Chart (figure 7-15 or 7-16).

(3) Emergency — Single-engine rates of climb from Single-Engine Climb Chart (figure 7-19 or 7-20).

(3) Complete departure planning by insuring the following conditions are satisfied.

1. Crosswind conditions are within the recommended area on the Crosswind-Takeoff or Landing Chart (figure 7-7 or 7-8).

2. Takeoff distances required are less than distances available.

3. Single-engine rate-of-climb with gear down is positive.

4. Obstacles can be cleared in the event of engine failure.

b. Climb.

NOTE

Rate-of-climb determined here is valid only for the pressure altitude and temperature used. A change in pressure altitude and/or temperature will necessitate re-evaluation at the new atmospheric conditions.

(1) Determine the following before entering performance charts.

1. Atmospheric conditions.

PERFORMANCE PLANNING
(NORMAL TWO ENGINE PROCEDURES)

DEPARTURE

PRESS. ALT _____ FT FAT _____ °C
WIND: DIRECTION _____ SPEED _____ KT
RUNWAY: DIRECTION ____ LENGTH ____ SLOPE ____ % UP DN
OBSTACLES: HEIGHT ____ FT DISTANCE ____ FT
TAKEOFF WEIGHT ____ LB
AIRSPEEDS (IAS): Vmc _____ KT
ROTATION _____ KT
TAKEOFF _____ KT
OBSTACLE CLEARANCE _____ KT
FUEL FLOW _____ GAL/HR/ENG MAN PRESS _____ IN HG
TAKEOFF DISTANCES: GROUND ROLL DISTANCE _____ FT
OBSTACLE CLEARANCE DISTANCE _____ FT
ACCELERATION CHECK: DISTANCE _____ FT SPEED ____ KT

CLIMB

PRESS ALT _____ FT FAT _____ °C
WEIGHT _____ LB
CLIMB IAS _____ KT MAX R/C IAS _____ KT
MAX HP AVAILABLE _____ HP/ENG
LEVEL FLIGHT HP REQUIRED _____ HP/ENG
CLIMB HP AVAILABLE _____ HP/ENG
ENG SPEED _____ RPM MAN PRESS _____ IN HG
FUEL FLOW _____ GAL/HR/ENG LB/HR/ENG _____ LB/HR
R/C _____ FT/MIN

CRUISE

PRESS ALT _____ FT FAT _____ °C
WEIGHT _____ LB
TAS _____ KT IAS _____ KT
LEVEL FLIGHT HP _____ HP/ENG _____ HP
ENG SPEED _____ RPM MAN PRESS _____ IN HG
FUEL FLOW _____ GAL/HR/ENG LB/HR/ENG _____ LB/HR

ARRIVAL

PRESS ALT _____ FT FAT _____ °C
WIND: DIRECTION _____ SPEED _____ KT
RUNWAY: DIRECTION ____ LENGTH ____ FT. SLOPE ____ % UP DN
WEIGHT _____ LB APPROACH IAS _____ KT
LANDING GROUND DISTANCE _____ FT

PREFORMANCE PLANNING
(EMERGENCY SINGLE-ENGINE PROCEDURES)

DEPARTURE

R/C GEAR DOWN _____ FT/MIN R/C GEAR UP _____ FT/MIN
CLIMB IAS _____ KT (OBSTACLE CLEARANCE IAS)

CLIMB

PRESS ALT _____ FT FAT _____ °C
WEIGHT _____ LB
CLIMB IAS _____ KT MAX R/C IAS _____ KT
MAX HP AVAILABLE _____ HP/ENG
LEVEL FLIGHT HP REQUIRED _____ HP/ENG
CLIMB HP AVAILABLE _____ HP/ENG
ENG SPEED _____ RPM MAN PRESS _____ IN HG
FUEL FLOW _____ GAL/HR/ENG _____ LB/HR/ENG
R/C _____ FT/MIN

CRUISE

PRESS ALT _____ FT FAT _____ °C
WEIGHT _____ LB
TAS _____ KT IAS _____ KT
LEVEL FLIGHT HP _____ HP/ENG
ENG SPEED _____ RPM MAN PRESS _____ IN HG
FUEL FLOW _____ GAL/HR/ENG LB/HR/ENG _____ LB/HR

GLIDE

HEIGHT ABOVE TERRAIN _____ FT WEIGHT _____ LB
GLIDE IAS _____ KT
GLIDE DISTANCE _____ NM

AP 002083

Figure 7-1. Performance Planning Card

(I) 12. Prop anti-ice — Check operation by rotating PROP ANTI-ICE rheostat clockwise and checking for liquid flow on propeller blades. Return ANTI-ICE rheostat to off position.

13. Battery lock switch — OFF.

CAUTION

If high winds are present, do not unlock the flight controls until ready for exterior inspection, as control surfaces may be damaged by buffeting.

14. Flight controls — Unlocked.

15. Trim tabs — Zero.

* 16. Parking brakes — Set.

17. Fire extinguisher — Check.

18. First aid kits (2) — Check.

19. Cabin door — Check.

b. Exterior Check (Figure 8-1).

NOTE

Fuel and oil quantity, quality and cap security check may be performed prior to EXTERIOR CHECK to preclude carrying ladder and bottle around during the inspection.

* *(1) Fuel sample* — Check collective fuel sample for contamination.

(2) Aft baggage area.

(O) 1. Oxygen system — Check pressure gage (1800 PSI). If oxygen use is anticipated, valve open.

2. Cargo — Secured.

(O) 3. Baggage door - As required.

(3) Fuselage right side.

1. Skin condition — Check for skin damage, such as buckling, cracking, splitting, distortion or dents.

2. Static ports — Check for freedom from dirt or obstructions.

(O) 3. Antennas — Check for security and broken wire.

(O) 4. Bumper — Check.

* 5. Tiedown — Released.

(4) Empennage.

(O) 1. Ground-plane wire — Check for condition and mounting on horizontal stabilizer.

2. Deicer boots (right side) — Check bonding secure, boots free of cuts and cracks.

3. Right horizontal stabilizer — Check security, cracks, and skin condition.

(O) 4. Static wicks — Check security.

5. Right elevator and trim tab — Check security, condition, and freedom of movement.

6. Navigation light and beacon — Check condition.

7. Rudder and trim tab — Check security, condition, and freedom of movement.

8. Vertical stabilizer — Check skin condition.

9. Left elevator and trim tab — Check security, condition, and freedom of movement.

(O) 10. Static wicks — Check security.

11. Left horizontal stabilizer — Check security, cracks, and skin condition.

12. Deicer boot (left side) — Check bonding secure, boots free of cuts and cracks.

(O) 13. Ground-plane wire — Check for condition and mounting on horizontal stabilizer.

(5) Fuselage left side.

1. Skin condition — Check for skin damage, such as buckling, cracking, splitting, distortion or dents.

2. Static ports — Check for freedom from dirt or obstructions.

(6) Left wing.

1. Skin condition — Check for skin damage, such as buckling, cracking, splitting, distortion or dents.

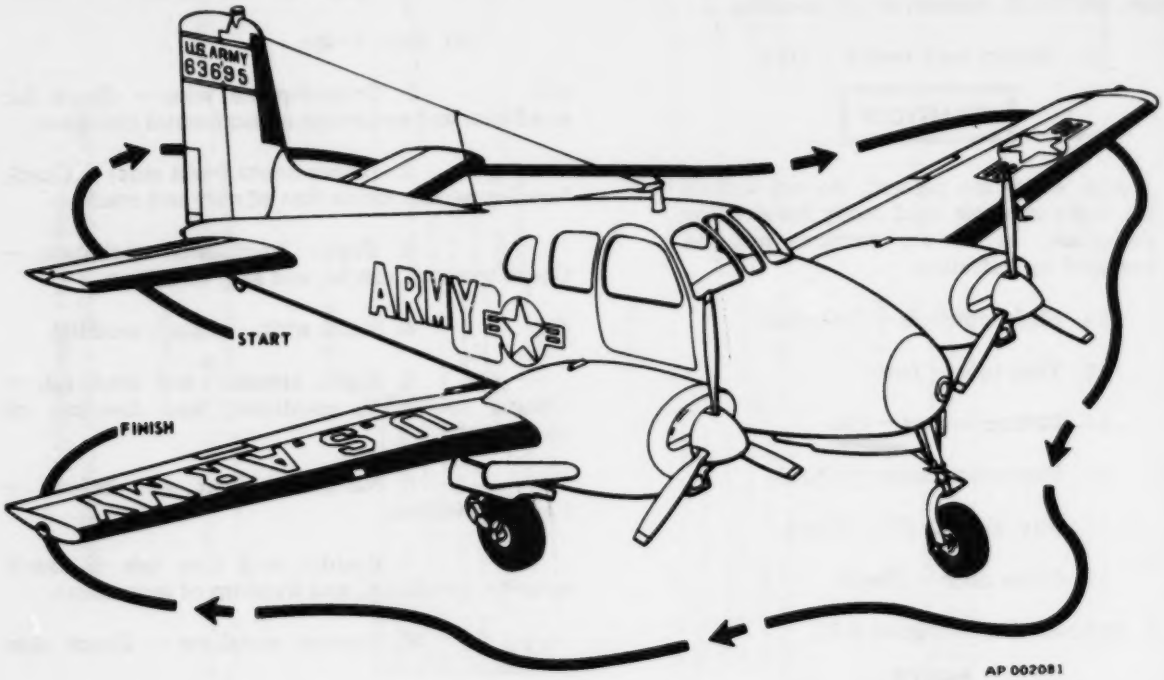


Figure 8-1. Exterior Check (Typical)

2. Controls and trim tab — Check hinge attachment and trim tab rig.

(O) 3. Static wicks — Check.

4. Wing tip and navigation light — Check.

(O) 5. Antennas — Check for security.

(O) 6. Ground-plane wire — Check at wing tip mounting.

7. Deicer boots — Check bonding secure and free of cuts and cracks.

8. Stall warning vane — Check.

* 9. Tiedown — Released.

* 10. Pitot tube — Check pitot for freedom of obstructions.

11. Landing light — Check.

* 12. Auxiliary fuel tanks — Check fuel level visually, seal installed and cap tight.

13. Left augmentor tube — Check.

(7) Left main landing gear.

* 1. Tire — Check for cuts, bruises, wear and proper inflation.

2. Wheel brake assembly — Check brake lines for damage or signs of leakage. Check brake pucks for wear.

* 3. Shock strut — Check for leakage and extension (3-INCH MINIMUM).

4. Safety switch box — Drain holes open.

5. Torque knee — Check.

6. Actuator spring — Check.

7. Gear doors and linkage — Check.

8. Wheel well condition — Check for fuel and oil leaks.

9. Oil shutoff valve check (open position).

10. Chock — As required.

(8) Left engine and propeller.

1. Engine compartment, cowling and access door — Check (left side).

2. Left cowling locks — Locked.

3. Carburetor air filter — Check free of obstructions.

4. Propeller blades and spinner — Check blades for nicks and security and spinner for slippage.

5. Engine compartment, cowling, and access door — Check (right side).

6. Right cowling locks — Locked.

* 7. Engine oil supply — Check oil level and filler cap secure.

(9) Left center wing.

(I) 1. Propeller anti-icing fluid — Check.

* 2. Left main fuel tank — Check fuel level visually. Check cap seal for condition and assure that cap is tightened properly.

3. Right augumentor tube — Check.

(10) Fuselage underside.

1. General condition — Check.

(O) 2. Antennas — Check for security and broken wire.

(11) Nose section.

1. Wheel well condition — Check for fuel and oil leaks.

2. Gear doors and linkage — Check.

* 3. Tire — Check for cuts, bruises, wear and proper inflation.

4. Torque knee — Check.

5. Actuator spring — Check.

* 6. Shock strut — Check for leakage and extension **(5-INCH MINIMUM).**

7. Shimmy damper and attaching linkage — Check.

8. Heater air intake — Check free of obstructions.

9. Chock — As required.

10. Passing (taxi) light — Check.

11. Nose compartment — Check door locked.

(12) Right center wing.

1. Left augmentor tube — Check.

(13) Right engine and propeller.

1. Engine compartment cowling and access door — Check (left side).

2. Left cowling locks — Locked.

3. Carburetor air filter — Check free of obstructions.

4. Propeller blades and spinner — Check blades for nicks and security, and spinner for slippage.

5. Engine compartment, cowling, and access door — Check (right side).

6. Right cowling locks — Locked.

7. Right augmentor tube — Check.

(14) Right main landing gear.

* 1. Tire — Check for cuts, bruises, wear and proper inflation.

2. Wheel brake assembly — Check brake lines for damage or signs of leakage. Check brake pucks for wear.

* 3. Shock strut – Check for leakage and extension (3-INCH MINIMUM).

4. Safety switch box – Check drain holes open.

5. Torque knee – Check.

6. Actuator spring – Check.

7. Gear doors and linkage – Check.

8. Wheel well condition – Check for fuel and oil leaks.

9. Oil shutoff valve – Check (open position).

10. Chock – As required.

(15) Right wing.

1. Auxiliary fuel tanks – Check fuel level visually, seal installed and cap tight.

2. Landing light – Check.

3. Tiedown – Released.

4. Deicer boots – Check bonding secure and free of cuts and cracks.

5. Wing tip and navigation light – Check.

(O) 6. Antennas – Check for security.

(O) 7. Ground-plane wire – Check for mounting and condition.

(O) 8. Static wicks – Check.

9. Controls and trim tabs – Check hinge attachment and trim tab rig.

10. Skin condition – Check for skin damage, such as buckling, cracking, splitting, distortion or dents.

(O) 11. Cabin step and retract mechanism – Check.

(O) 12. Baggage door – Rechecked/locked.

* 13. Right main fuel tank – Check. Check fuel level visually. Check seal is installed and cap is tight.

* 14. Engine oil supply – Check oil level and filler cap secure.

c. Interior Check.

* 1. Cargo and loose equipment – Secured.

(O) 2. Special mission equipment – Installed and secured.

(O) 3. Transponder computer – Installed/keyed.

* 4. Door – As required.

*★ 5. Crew/passenger briefing – As required (Section VI).

8-13. Before Starting Engines.

(O) 1. Special equipment switches – OFF.

2. Battery lock switch – OFF.

3. Free air temperature gage – Note reading.

4. Magnetic compass – Check for fluid, heading, and current deviation card.

* 5. Propeller levers – Low pitch (full forward).

* 6. Throttles – Set. Open approximately 1/2 inch.

* 7. Mixture levers – Idle cutoff.

8. Friction control – Check.

9. Cabin temperature rheostat – OFF.

10. Nose wheel indicator – Check. Note indicator position.

11. Generator circuit breakers – Check.

12. Gear circuit breaker – Check.

13. Gear emergency extension handle – Stowed.

14. Gear emergency extension clutch lever – Full left.

15. Oil shutoff valve handles – Down and locked.

* 16. Seats, pedals, belts, harnesses – Adjust.

17. Pilot's emergency transmitter switch — As required.

(O) 18. Glideslope receiver — OFF.

19. Pilot's audio control panel — Set.

20. Pilot's flight instruments — Check.

21. Marker beacon receiver — OFF.

22. Engine instruments — Check for correct readings and markings, note manifold pressure reading.

23. Copilot's flight instruments — Check.

24. Copilot's emergency transmitter switch — As required.

25. Radios, doppler navigation system, and transponder — OFF.

(O) 26. Radar beacon — OFF.

27. Copilot's audio control panel — Set.

28. Three-phase inverters — OFF.

29. One-phase inverters — OFF.

(O) 30. 750 VA inverter(s) — OFF.

31. Gyro horizon — OFF.

32. Gyro compass switch — MAGNETIC.

33. FM squelch — OFF.

(O) 34. Int FM — ON.

35. Navigation lights — STEADY.

36. Deicer — OFF.

37. Gear handle — DOWN.

38. Right subpanel circuit breakers — Check.

(O) 39. Instrument panel circuit breakers (right side) — Check.

(O) 40. Power distribution circuit breaker panel (overhead) — Check.

CAUTION

For GPU start, the battery and generator switches should be left in the OFF position. Due to the location of external power receptacle (left engine), it is recommended that the right engine be started first.

41. Battery switch — ON.

42. Generator switches — ON.

43. Ventilation heater air shutoff — As required.

44. Defroster shutoff — As required.

45. Flap switch — OFF.

46. Pitot heat — OFF.

47. Passing (taxi) light — OFF.

48. Landing lights — OFF.

49. Carburetor heat controls — IN.

50. Front seat cold air — As required.

51. Propeller anti-ice switch — OFF.

52. Left subpanel circuit breakers — Check.

53. Heater blower — OFF.

54. Suction gage selector — INSTR NORMAL.

* 55. Battery lock switch — ON.

56. Navigation lights — As required.

57. Warning and indicator lights — Test.

NOTE

Some lights will illuminate when power is applied, others must be pressed to test the bulbs.

58. Fuel gages — Check.

59. Anti-icing fluid gage — Check.

8-14. *Starting Engines.

EMERGENCY PROCEDURES - Paragraph 9-7.

Although either engine may be started first and the procedure is identical for both, the recommended practice is to start the left engine first.

NOTE

For GPU start, the battery and generator switches should be left in the OFF position. Due to the location of external power receptacle (left engine), it is recommended that the right engine be started first. Allow the step to fully retract before engaging starter. Start engine then retard throttle below 1000 RPM, disconnect the GPU, and then turn battery and generator switches ON.

*a. *Left Engine Start.*

1. Beacon — On.

2. Left boost pump — ON. Check fuel pressure.

3. Left magneto switch — ON.

4. Propeller — Clear.

CAUTION

If the engine has not started after 45 seconds of cranking, allow the starter to cool for 3 minutes before attempting another start.

5. Starter button — Press until engine starts.

NOTE

Priming prior to start will vary in accordance with the ambient temperature.

CAUTION

During cold starts in subfreezing weather, failure of engine to start may be due to insufficient prime. For nearly all normal starts, failure to start is usually the result of excessive fuel: having the mixture lever out of IDLE CUTOFF under this condition could result in a serious fire, if the engine backfires.

6. Primer button — Press. Prime as necessary.

NOTE

In cold weather, congealed oil in gage lines may result in a temporarily low oil pressure indication, as low as 10 pounds on engine oil pressure gage. Idle engine at a maximum of 600 to 1000 RPM until minimum idle oil pressure is indicated (25 PSI). Continue normal engine run-up upon indication of a minimum oil temperature of 38° C.

7. Left mixture lever — RICH, when engine fires.

NOTE

If engine starts and then stops firing, quickly move mixture lever to IDLE CUTOFF and hold approximately two engine revolutions or until engine fires again. Then move mixture lever back to RICH. If engine still fails to fire, move mixture lever to IDLE CUTOFF position, wait until engine stops rotating, and attempt restart.

CAUTION

Do not switch ON the right magneto until engine is running. At the low speed encountered during starting, the right magneto will fire considerably earlier than the left, with the possibility of a backfire.

8. Right magneto switch — ON.

9. Throttle — Set (800 to 1200 RPM).

CAUTION

If oil pressure does not rise to operating minimum within 30 seconds, shut down engine and investigate.

10. Oil pressure — Check.

11. Left boost pump — OFF. Check pressure.

NOTE

In warm weather, it is possible that fuel pressure drop will cause the engine to stop completely when the boost pump is turned off, due to high temperature in the engine compartment causing fuel vaporization in the fuel lines. Boost pumps should be left on during engine warmup long enough for cool fuel to reach the carburetor (normally 30 seconds will be sufficient). Lack of fuel pressure after turning OFF the boost pump may also indicate engine-driven fuel pump failure.

CAUTION

To prevent excessive wear on the engine, do not exceed 1600 RPM until oil temperature has reached operating minimum.

12. Throttle — Set **(1500 RPM)**. Check generator output.

*b. *Right Engine Start.*

1. Right boost pump — ON. Check fuel pressure.

(O) 2. Entrance step — Check, up.

3. Left magneto switch — ON.

4. Propeller — Clear.

5. Starter button — Press until engine starts.

6. Primer button — Press. Prime as necessary.

7. Right mixture lever — RICH when engine fires.

8. Right magneto — ON.

9. Throttle — Set **(800 to 1200 RPM)**.

10. Oil pressure — Check.

11. Right boost pump — OFF. Check pressure.

12. Throttle — Set **(1500 RPM)**. Check generator output.

8-15. Engine Ground Operation.

Warmup engine at 800 to 1200 RPM until oil pressure has stabilized and all temperatures show a definite increase. Then continue warmup at 1500 RPM. At subzero temperature, carburetor heat may be used for smooth operation.

NOTE

The use of heated air during engine warmup (ground operation) should be held to a minimum since unfiltered air is drawn into the induction system.

8-16. *Before Taxiing.

1. Radios — ON. Communication and navigation radios ON, transponder STBY.

2. Three-phase inverters — STANDBY check, set on MAIN.

3. One-phase inverters — STANDBY check, set on MAIN.

(O) 4. One-phase 750 VA inverter(s) — STANDBY check, set on MAIN.

(O) 5. Doppler — Standby.

6. Gyro horizon ON.

7. Vacuum system — Check that suction gage, left and right pump indicate operation within limits, then set on INSTRU NORMAL.

8. Radios — Check operation as required.

(O) 9. Mission equipment operation — Check as required.

10. Taxi clearance — Check.

11. Clock — Set.

12. Altimeter — Set, check tolerance.

13. Chocks — Remove.

14. Parking brake — Release.

8-17. *Taxiing.

No special techniques are required during taxi operations. Observe gyro instruments during turns for proper response. If for any reason the aircraft is stopped, maintain 1500 RPM to avoid overheating and to maintain sufficient generator output. While taxiing, perform the following checks:

1. Brakes — Check operation.

2. Flight instruments — Check settings and operation within limits.

8-18. Engine Runup.

EMERGENCY PROCEDURES - Paragraph 9-7.

Stop the aircraft headed into the wind if possible with the nose wheel centered and perform the following checks:

* 1. Nose wheel — Centered.

* 2. Parking brake — Set (keep feet on rudder pedals).

CAUTION

Perform this check as rapidly as possible to minimize the possiblity of a backfire.

*★ 3. Magnetos groundout — Check at 700 to 900 RPM by turning the magneto switches OFF individually, then both switches OFF momentarily. Engine should stop firing when both switches are in the OFF position only.

* 4. Throttles — Set (1500 RPM).

5. Flaps — Check operation of 4 panels.

* 6. Engine instruments — Check that pressure and temperatures are within operating limits.

CAUTION

Limit operation on one magneto from 3 to 4 seconds to avoid fouling spark plugs.

*★ 7. Magnetos — Check at 2600 RPM by turning OFF one magneto at a time and checking that RPM drop does not exceed 125.

NOTE

Keep in mind that operation on one magneto is accomplished by turning the opposite magneto OFF; for example, if the right magneto switch is turned OFF, the left magneto is being checked.

CAUTION

Cycle deicing system one time only because of overheating.

*(I) 8. Deicing system — Check by activating DEICER switch and visually checking expansion of boots and deicing pressure, then return switch to OFF.

*★ 9. Propeller governors — Check by placing propeller levers in high pitch and checking for stabilized RPM at 2350 to 2400 RPM. Return levers to low pitch.

NOTE

Move propeller lever forward and back to detent several times to insure warm oil supply to propeller and governor.

★ 10. Generator voltage — Check by pressing both volt-ammeter push-buttons and check for proper voltage (27.5 to 28.5).

CAUTION

Accomplish the power check on paved areas when possible, since damage to the aircraft could result from loose gravel being kicked up by propeller wash.

★ 11. Engine power — Check by setting throttle to field barometric pressure and note RPM at 2900 ± 100.

* 12. Throttle — Set (1500 RPM).

CAUTION

A feathering check should not be accomplished with an engine speed above 1500 RPM with sea level standard barometric pressure conditions, since excessive cylinder pressure will result.

*★ 13. Propeller feathering — Check. With the throttle set at 1500 RPM and the propeller levers set in low pitch, place the propeller levers in feather. Reset the propeller levers to low pitch before the engine drops to 1000 RPM.

14. Carburetor heat — Check by slight drop in manifold pressure and rise in carburetor air temperature when heat is applied.

(O) 15. Doppler system — Check. Refer to Chapter 3.

(O) 16. ARD-15 system — Check. Refer to Chapter 4.

(O) 17. Driftmeter — Check. Refer to Chapter 3.

8-19. *Before Takeoff.

1. Fuel panel — Check, fuel selectors and boost pumps on MAIN.

2. Flaps — As required (normally, takeoff is made with zero flaps).

★ 3. Carburetor heat — Check as required.

NOTE

For ambient temperatures of 0°C or above, set pre-takeoff carburetor heat by setting throttles to 2600 RPM, then adjusting carburetor heat levers until manifold pressure drops 1/2 in. Hg. For temperatures 0°C to -10°C adjust for a 1 in. Hg. drop, and for temperatures of -10°C or below adjust for a 1-1/2 in. Hg. drop. Refer to Chapter 2, and Section V of this Chapter for additional information concerning the use of carburetor heat under conditions favorable for induction system ice.

4. Propeller levers — LOW PITCH (full forward).

5. Mixture levers — Rich.

6. Trim — Set.

7. Engine and flight instruments — Check.

8. Flight controls — Check for full travel and proper response.

9. Navigation radios — Set, as required.

10. Takeoff clearance — As required.

11. Windows and doors — Secure.

12. Anti-icing/deicing/pitot heat — As required.

13. Parking brake — Release.

*8-20 Line Up.

CAUTION

The two center windows must be closed and locked at all times in flight. The pilot's storm window must be closed above 125 KIAS.

1. Transponder — As required.

(O) 2. Radar beacon — As required.

3. Gyro heading — Check.

NOTE

Prior to flight, the gyro magnetic compass indicator should be crosschecked with the magnetic compass to verify approximate heading as the indicator annunciator window will also be clear (blank) if the heading is 180° out of phase.

(O) 4. C-12 compass — Align.

(O) 5. Doppler — As required.

6. Landing/taxi lights — As required.

8-21. Takeoff.

EMERGENCY PROCEDURES - Paragraph 9-5.

Plan the takeoff according to the following variables affecting takeoff techniques: field elevation, gross weight, wind, free air temperature, type of runway, and height and distance of the nearest obstacles. To aid in planning the takeoff and to gain maximum aircraft performance, make full use of the information affecting takeoff which is furnished in Chapter 7.

CAUTION

The maximum power limits indicated on the engine instruments are applicable at sea level standard day conditions. For limiting manifold pressure at other than sea level standard day conditions, refer to Chapter 7.

a. Normal Takeoff. Advance throttles smoothly to takeoff power. Directional control during initial portion of takeoff run can be maintained with nose wheel steering, up to the speed where rudder control becomes effective. Refer to Chapter 7 for correct rotation and lift-off speed. Use brakes only in an emergency, since every application of the brakes on the takeoff roll will lengthen the takeoff run. Retract the landing gear when flight is assured and accelerate to the appropriate enroute climb speed.

b. Crosswind Takeoff. In accomplishing a crosswind takeoff, directional control may be more difficult to maintain; therefore, lead with upwind throttle at beginning of takeoff roll, gradually reducing the lead as increased speed reduces the aircraft's weather-vaning tendency. Hold the nose wheel on the ground and apply upwind aileron to minimize the tendency to side skip as flying speed is approached. Firmly pull the aircraft off the ground as required flying speed is reached. Make the pull off positive to keep from sideskipping as weight is lifted from the shock struts. Initial drift correction is applied by turning sufficiently with a

shallow turn to counteract all drift and then rolling the wings level with coordinated control movement. Continue to climb straight ahead maintaining drift correction attitude.

WARNING

Minimum run takeoffs and obstacle clearance climbs are performed below Vmc and near single-engine stall speed. Directional control of the aircraft will be lost if an engine failure occurs at or immediately following liftoff until power is reduced on the operative engine.

c. Minimum Run Takeoff. Minimum run takeoffs are performed with flaps set at 20°. After the LINE UP checks are completed, release brakes as manifold pressure passes 40 in. Hg. As soon as elevator control becomes effective (approximately 55 KIAS) raise the nose wheel clear of the runway. Continue to apply elevator pressure in a smooth continuous motion. Retract the landing gear when flight is assured. Establish 95 KIAS, retract the wing flaps and accelerate to 110 KIAS before establishing a normal climb attitude.

d. Obstacle Clearance Climb. The procedures required to accomplish an obstacle clearance takeoff will be the same as those for minimum run takeoff to the point where landing gear has been retracted; at this time the climbing attitude of the aircraft should be adjusted to attain the steepest angle of climb possible at approximately 75 KIAS. When all obstacles are safely cleared, level off to gain normal climbing airspeed, retracting flaps at 95 KIAS, and continue climb.

e. Night Takeoff. Night takeoff procedures are the same as daytime takeoff. Familiarity with the location of all switches and controls in the cockpit is essential. The landing and/or taxi lights may be used for takeoff as required.

8-22. After Takeoff.

EMERGENCY PROCEDURES - Paragraph 9-5.

After the aircraft is definitely airborne, perform the following steps as applicable:

1. Gear — UP.
2. Flaps — UP.
3. Landing/taxi lights — As required.

CAUTION

To prevent excessive pressures within the cylinders when reducing power, always reduce manifold pressure first, then reduce RPM. When increasing power, increase RPM first, then increase manifold pressure.

4. Climb power — Set by adjusting manifold pressure and propellers to 3200 RPM (Chapter 7).

5. Boost pumps — OFF (Check pressure).

CAUTION

Excessively high carburetor temperatures will cause detonation and loss of power.

6. Carburetor heat — As required.

7. Wings and nacelles — Check for fuel and oil leaks.

CAUTION

The mixture lever must be set to the RICH position under all operating conditions. Manual leaning is not permitted. The mixture lever may be moved from the RICH position only when stopping the corresponding engine.

8-23. Climb - Normal.

Normal climb is performed at 120 KIAS at normal rated power of climb. For specific recommended climb airspeeds refer to Chapter 7. Monitor engine temperatures during extended climbs. If cylinder head temperature or oil temperature is approaching redline limits, airspeed should be increased or power reduced to insure proper cooling.

NOTE

When operating in areas of visible moisture, or when susceptible to induction ice, maintain a +55°C to 60°C reading on the carburetor air temperature gage.

8-24. Climb - Max Rate.

The maximum rate-of-climb airspeed is 105 KIAS at sea level standard conditions. However,

due to engine cooling requirements, a climb airspeed of 115 KIAS is recommended. In order to maintain this performance, reduce airspeed approximately one knot for each 1000 feet of altitude.

8-25. Cruise Checks.

EMERGENCY PROCEDURES - Paragraph 9-5.

CAUTION

Avoid rapid closing or opening of the throttles when operating with high engine RPM and high manifold pressure. Operating under conditions of high engine RPM (2800 RPM or higher) and low manifold pressure (under 15 inches Hg.) is to be avoided also. Either of these operating conditions may unbalance or detune the crankshaft vibration dampeners and cause internal engine failure.

In general, cruise power settings are entirely dependent upon the prevailing circumstances and the type of mission being flown. Refer to Chapter 7 for the necessary flight planning information. Refer to Chapter 2 for necessary fuel system management. The following procedures are applicable to all cruise requirements:

1. Power — Set.

2. Fuel selectors — As required.

3. Wings and nacelles — Check for fuel and oil leaks.

(O)★4. Nickel-cadmium battery condition check.

(1) Monitor volt-ammeter (amperage) during flight. An increase without obvious reason indicates a possible deteriorating battery.

(2) Turn battery switch OFF. A DECREASE reading of 1/4 or more graduation (approx. one needle width) verifies a deteriorating battery.

(3) Leave battery switch off for remainder of flights.

(4) Turn battery switch ON prior to BEFORE LANDING check.

(5) Make any necessary entries on DA Form 2408-13 for maintenance purposes.

8-26. Descent.

EMERGENCY PROCEDURES - Paragraph 9-11.

CAUTION

Airspeed picks up quickly when the nose is lowered; use caution not to exceed the maximum allowable indicated airspeed.

a. Descent - Normal. Descent from cruising altitude should normally be made by letting down at cruising airspeed with reduced throttle. Avoid prolonged glides with throttles closed, as engines will load up and overcool. During descent, it is important to cushion the high inertia loads on the rod bearings which occur at conditions of high RPM and low manifold pressure. As a general rule, it is well to remember that each 100 RPM requires at least 1 inch Hg. manifold pressure. For example: 26 inches Hg. at 2600 RPM. Operation above 2750 RPM with low manifold pressure should be kept to a minimum.

b. Descent - Max Rate. Maximum rate of descent in landing configuration may be obtained by using the following procedure:

1. Props — 2600 RPM.

2. Gear — DOWN (130 KIAS).

3. Flaps — DOWN.

4. Airspeed — 120 KIAS.

5. Throttles — 15 in. Hg.

8-27. Descent - Arrival Check.

Perform the following checks prior to pattern entry:

1. Seat belts and shoulder harnesses — Secure (crew/passengers checked).

2. Fuel-control panel — Check fuel selectors and boost pumps on MAIN.

3. Carburetor heat — As required.

4. Landing/taxi lights — As required.

8-28. Before Landing.

EMERGENCY PROCEDURES - Paragraph 9-11.

1. Carburetor heat — As required (normally carburetor heat is OFF for landing).

(O) 2. Doppler navigation system — OFF.

3. Gear — DOWN and check (below 130 KIAS).

4. Landing lights — ON.

8-29. Obstacle Clearance Approach.

Fly a normal traffic pattern completing the before landing checks as previously described. Lower flaps on base leg as required and complete final landing check after turning final. Adjust pitch, power and flaps to maintain the desired approach angle and airspeed so as to arrive at the intended landing point at minimum touchdown speed consistent with existing conditions. The approach angle should allow safe clearance above all obstructions in the approach path.

NOTE

Obstacle clearance approach speeds may be below Vmc.

8-30. Landing.

EMERGENCY PROCEDURES - Paragraph 9-12.

CAUTION

Do not advance propeller levers to low pitch with airspeed above 100 KIAS. Engine operation with high RPM and low manifold pressure is to be avoided, since engine detuning may result. For further engine detuning information, refer to Chapter 5.

Perform the following checks during the final leg of the traffic pattern:

1. Gear — Recheck DOWN.

2. Propellers — As required.

NOTE

In situations requiring maximum performance, propeller levers should be placed at low pitch.

CAUTION

The RU-8D maximum bank angle while landing is 5°.

a. Normal Landing. In order to obtain the results stated in Chapter 7, observe the following precautions and technique: Flareout and retard the throttles at the same time, touching down with power off. As the aircraft decelerates, allow the nose wheel to gently contact the runway, losing as much speed as practicable before using brakes. Braking will be less effective until weight of the aircraft settles on the landing gear. Hold control column in neutral while braking and keep the aircraft straight with rudder and nose wheel steering.

b. Minimum Run Landing. For minimum run landing, lower wing flaps to 30 degrees on final approach, reduce airspeed to 80 KIAS and maintain approach path with power. Since the aircraft will have a more nose high pitch attitude than during a normal landing approach, rotation for landing touchdown will be made at a somewhat lower altitude. Reduce power slowly during approach to avoid establishing a high rate of sink; cut power at touchdown and immediately lower nose wheel (gently) to the runway and apply brakes as required.

c. Crosswind Landing.

CAUTION

The RU-8D maximum bank angle while landing is 5°.

Less wing flaps should be used generally, depending on the severity of the wind. Use a crab and upwind wing low attitude to correct for the drift. If necessary, carry a little power on the upwind engine. Eliminate crab prior to runway contact and land on upwind main landing gear. Allow the aircraft to settle to the other main landing gear, reduce power, and lower the nose wheel to the runway as soon as practicable to preserve directional control.

d. Night Landing. The pre-landing procedures for night operation are the same as used during a normal landing with the exception of using the different lighting elements. Power usage completely through the approach, flare out and actual touchdown is desirable when it is difficult to estimate the aircraft's exact altitude. By holding

partial power, the aircraft will settle to the runway. Just as the ground is contacted, power should be cut off. Avoid using landing lights in thick haze, smoke, or fog as reflected light from the particles in the air will reduce visibility.

CAUTION

Due to mission antenna configuration landing RU-8D on unprepared surface should be avoided except in extreme emergencies.

e. Landing on Unprepared Runway. Landing procedure for unprepared strips is the same as normal landing on paved runways, except that if the surface is very rough, touch down as smoothly as possible to minimize shock loads on the landing gear. Use brakes with caution on soft or uncertain ground, to prevent digging the nose wheel into the ground.

8-31. Go-Around.

A go-around should be performed when it becomes apparent that a landing cannot be completed (for missed approach during instrument flight, refer to Section III). Accuracy of judgement and early recognition of the need to go-around are important. The decision should be made as early as possible to provide a safe margin of airspeed and altitude. When a go-around is commenced in the traffic pattern prior to the LANDING CHECK, use power as required, establish a climb attitude, and complete the go-around procedure as applicable. A go-around started after the LANDING CHECK has been performed or during "flare-out" is a critical maneuver since the aircraft is in a landing configuration, at a slower airspeed, and close to the ground. After power is applied to initiate the go-around, stop the descent before completing the go-around procedure. In a go-around situation, perform the following procedure as applicable:

1. Takeoff Power — Set (Chapter 7).

CAUTION

If carburetor heat is in use, monitor carburetor heat gages as power is applied.

2. Gear — UP.
3. Flaps — UP.
4. Carburetor heat — As required.
5. Landing/taxi lights — As required.
6. Climb power — Set.
7. Boost pumps — OFF (check pressure).

8-32. After Landing (Clear of Runway).

Perform following checks after the aircraft has cleared the runway:

1. Propeller levers — LOW PITCH.
2. Landing/taxi lights — As required.
3. Boost pumps — OFF.
4. Flaps — UP.
5. Carburetor heat — As required.
6. Anti-ice/deice/pitot heat — OFF.
7. Transponder — As required.

(O) 8. Radar beacon — OFF.

(O) 9. Special mission equipment — OFF.

(O) 10. Voice security computer — As required.

(O) 11. Doppler destination coordinates — As required.

12. Radios — As required.

8-33. Engine Shutdown.

1. Nose wheel — Centered.
2. Parking brakes — Set.

★ 3. Magneto groundout — Check.

4. Throttles — Set (1500 RPM).
5. Inverters — OFF.
6. Radios — OFF.
7. Heater — OFF.
8. Nonessential electrical equipment — OFF.

NOTE

If cylinder head temperatures are excessive, run engines at approximately 1000 RPM until temperatures are within limits.

9. Right engine mixture — IDLE CUTOFF.

(O) 10. Step — Down.

11. Left engine mixture — IDLE CUTOFF.

12. Magnetos — OFF (after propellers stop).

13. Fuel selectors -- As required.

14. Lighting systems — OFF.

15. Beacon — OFF.

16. Battery lock switch — OFF.

8-34. Before Leaving Aircraft.

1. Wheels — Chocked.

2. Parking brakes — As required.

3. Flight controls — Locked.

(O) 4. Voice security computer — Removed.

(O) 5. Transponder computer — Removed.

(O) 6. Transponder — Check, zeroized.

7. Windows and door — As required.

8. Walk around inspection completed.

NOTE

In addition to established requirements for reporting any system defects, unusual and excessive operation such as hard landing, etc., the flight crew will also make entries on DA Form 2408-13 to indicate when limits in the Operator's Manual have been exceeded.

9. DA Form 2408-12 and -13 — Completed.

10. Aircraft — Secured.

Section III. INSTRUMENT FLIGHT

8-35. General.

This aircraft is qualified for operation in instrument meteorological conditions. Flight handling, stability characteristics, and range are the same during instrument flight conditions as when under visual flight conditions. Adequate navigation and communication equipment is installed to provide instrument flight.

NOTE

To be certain of proper instrument operation allow approximately 8 minutes warmup time prior to takeoff. During this ground warmup period, adjust engine speed to maintain generator output, since radio and other electrical equipment will be in operation.

8-36. Instrument Flight Procedures.

Refer to FM 1-5, TM 1-300, FLIP AR 95-1, FAR Part 91, and procedures described in this manual.

a. Instrument Takeoff. Complete the normal checks prescribed in this chapter. When ready for takeoff, align the aircraft with the center of the runway. Allow it to roll straight ahead for a few feet before stopping so the nose wheel will be straight. Hold the brakes and note the heading to be maintained during takeoff roll. Follow takeoff procedures dictated by local conditions.

NOTE

A slight amount of pitch error in the indication of the attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after an acceleration and a slight dive indication after deceleration. The error will be most noticeable at the time the airplane breaks ground during takeoff. At this time, a climb indication error of approximately one-half of the bar width will normally be noticed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual takeoff. The erection system will automatically remove the error after the acceleration ceases.

b. Instrument Climb. Instrument climbs are normally performed at 120 KIAS. For specific recommended climb airspeeds refer to Chapter 7. When safe altitude and climb airspeed are attained, reduce to climb power and complete the after takeoff checks as prescribed in this chapter.

c. Instrument Cruise. There are no unusual flight characteristics during cruise in instrument meteorological conditions.

d. Instrument Descent. When a descent at lower than cruising airspeed is desired, slow the aircraft to the desired airspeed before starting the descent. Normal descent or radar controlled descent to traffic pattern altitude can be made using cruise airspeed. Normally, descent will be made with the aircraft in a clean configuration. Maintaining cruising speed and reducing manifold pressure approximately 1 in. Hg. for each 100 feet per minute of descent desired. The aircraft is completely controllable in a high rate of descent with landing gear and wing flaps extended. At least 1 in. Hg. manifold pressure should be maintained for each 100 engine RPM. Prior to descent through visible moisture, apply carburetor heat and anti-icing equipment as required.

e. Holding. Recommended holding airspeed is 120 KIAS. Maintain cruising RPM and sufficient manifold pressure to maintain the desired holding airspeed. For extended holding periods see the appropriate fuel and power charts in Chapter 7. For descents in the holding pattern, reduce power and maintain holding airspeed.

f. Instrument Approaches. Instrument approaches are normally performed at 120 KIAS. Various procedures can be used for instrument approaches. Whether letdowns are made in clean or in landing configuration is at the discretion of the pilot. Icing conditions, turbulence, or action to be accomplished when the aircraft reaches the lower altitude will govern the type of letdown. If it is necessary to make an emergency instrument landing, the rate of descent during the last 1000 feet should be adjusted to less than 500 feet per minute, maintaining cruising RPM, and manifold pressure as required.

8-37. Night Flying.

Night flying is very closely related to instrument flying and may often be conducted almost entirely under instrument conditions. Before takeoff, it is imperative to ensure that all lights, instruments, and avionic equipment are functioning properly. Generally, interior lighting should be kept to the minimum amount which will still allow complete visibility of all instruments and gages. Excessive cockpit lighting decreases outside visibility. Avoid using landing lights when in thick haze, smoke, or fog, as reflected light will reduce visibility and may affect depth perception. During ground operations, the aircraft should be taxied slowly. Once rolling it is difficult to judge actual ground speed and excessive speeds may be developed without realizing it.

Section IV. FLIGHT CHARACTERISTICS

8-38. Normal Flight Characteristics.

The flight characteristics control and stability of the aircraft are normal throughout its speed range. When correctly trimmed, the aircraft tends to remain in straight and level flight. Extending and retracting the landing gear and wing flaps or changes in power settings cause changes in control pressure which are easily manageable.

8-39. Stalls.

Ample warning of stall in the form of buffeting and an audible signal from the stall warning horn (refer to Stall Warning System Chapter 2) is given during the approach to the stall.

If power stall recovery technique is used, little altitude will be lost during the recovery. Stall speeds for various flight configurations and banked turns are given in figure 8-2 or 8-3.

a. Power-on Stalls.

CAUTION

A power-on stall (closely resembling a spin entry) may be encountered if the RU-8D is stalled from a steeply banked, (30°+) nose high, right climbing turn, particularly if the flaps are used.

GREEN

STALL SPEED
POWER IDLE

STALL SPEED
U-8D, U-8G
O-480-1

EXAMPLE

WANTED

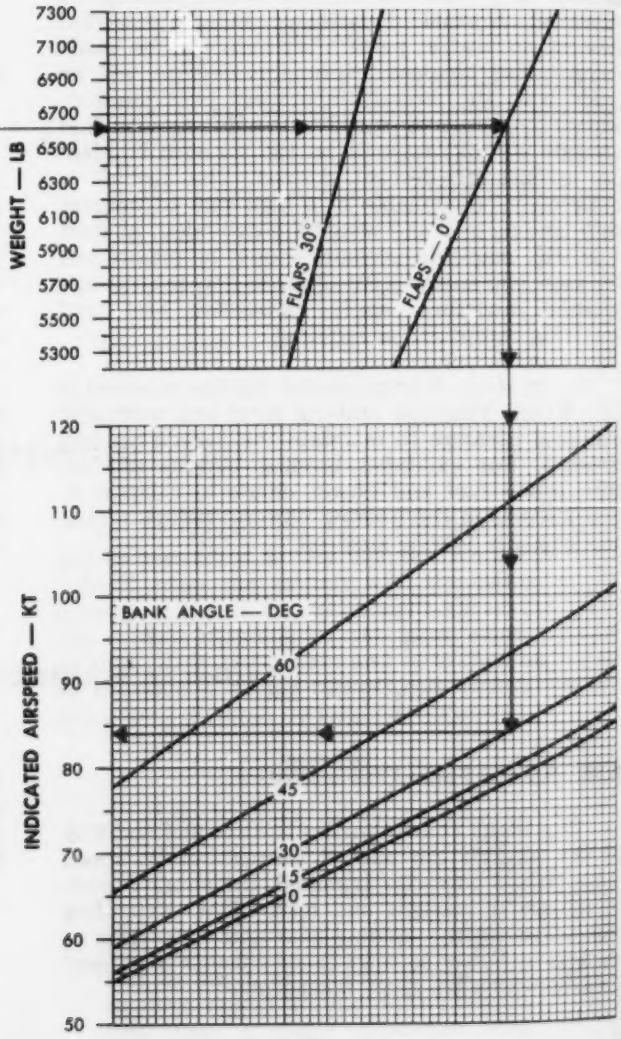
STALL SPEED

KNOWN

WEIGHT = 6620 LB
FLAP SETTING = 0°
BANK ANGLE = 30°

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN TO BANK ANGLE
MOVE LEFT, READ STALL SPEED = 84 KTS - IAS



AP 001870

Figure 8-2. Stall Speed Chart (U-8D, U-8G)

GREEN

STALL SPEED
POWER IDLE

STALL SPEED
RU-8D
O-480-1

EXAMPLE

WANTED

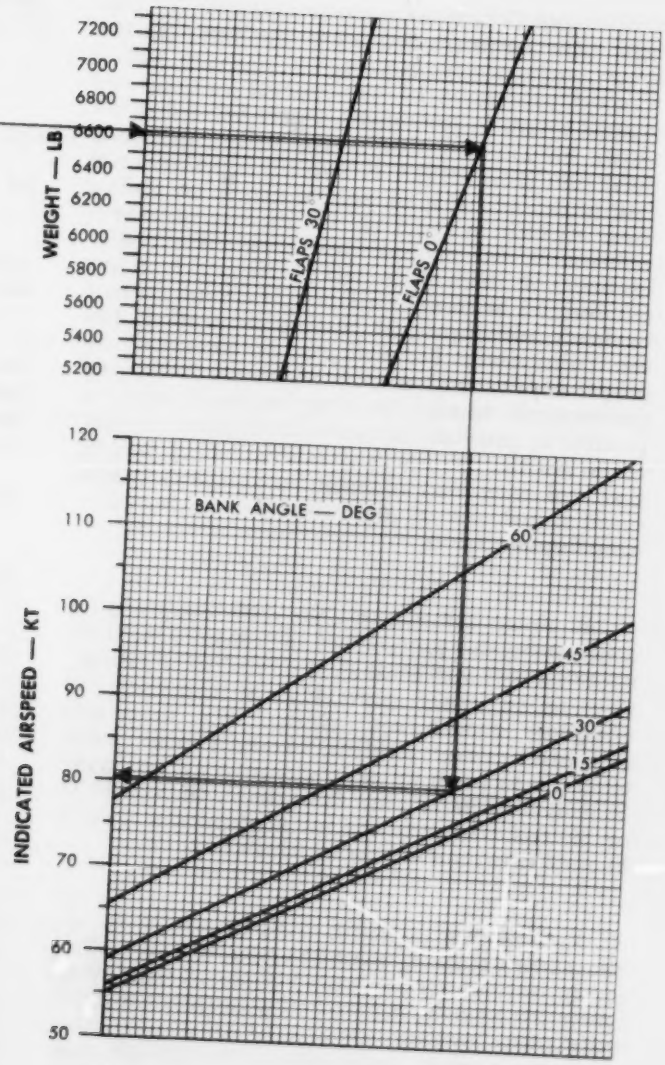
STALL SPEED

KNOWN

WEIGHT = 6620 LB
FLAP SETTING = 0°
BANK ANGLE = 30°

METHOD

ENTER WEIGHT HERE
MOVE RIGHT TO FLAP SETTING
MOVE DOWN TO BANK ANGLE
MOVE LEFT, READ STALL SPEED = 80 KT - IAS



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 002000

Figure 8-3. Stall Speed Chart (RU-8D)

(1) The power-on stall attitude is very steep and it is difficult to stall the aircraft inadvertently in any normal maneuver. Ample stall warning in the form of "mushy" controls and mild buffeting of the horizontal stabilizer is felt in the approach to the stall, accompanied by a continuous tone from the stall warning horn. The stall itself is characterized by a clean drop of the nose accompanied by a possible rolling tendency. The rolling tendency is eliminated by use of rudder and aileron.

(2) Control is regained very quickly with little altitude loss, providing the nose is not lowered excessively. Accomplish recovery with a forward movement of the control column and gradual return to level flight. Figure 8-2, 8-3 or 8-4 shows the indicated buffet and stalling speeds at maximum gross weight in two configurations and four angles of bank. In normal power on stalls a steep attitude is required. Unless this attitude is maintained, the aircraft will generally "mush" instead of stall. The roll tendency is more pronounced in power-on stalls, as is the pitching tendency, although both may be controlled after the initial stall. The roll can be prevented by proper rudder and aileron pressures. If the roll develops, it should be terminated as soon as possible to preclude excessive bank. Power-on stall characteristics are not greatly affected by landing gear and wing flap position, except that stalling speed is reduced in proportion to the degree of wing flap extension.

b. Power-off Stalls. The roll tendency is considerably less pronounced in power-off stalls (in either takeoff and landing, or clean configuration), and more easily prevented or corrected by adequate rudder and aileron. The nose will generally drop straight through, with some tendency to pitch up again if recovery is not made immediately. With wing flaps down, there is little or no roll tendency and stalling speed is 7 to 8 knots slower than with wing flaps up.

c. Accelerated Stalls. Accelerated stalls are caused by imposing more than the normal pull of gravity on the aircraft, thereby increasing the stall speed. This can be done by increasing the aircraft's weight due to centrifugal force in a turn or an abrupt increase in pitch attitude. The aircraft gives noticeable stall warning by slight buffet and a continuous tone from the stall warning horn. This may be demonstrated by applying excessive back pressure on the control column when in turns. Recovery procedure and technique is the same as used for power-on stalls.

8-40. Spins.

CAUTION

Do not pull out of the resulting dive too abruptly as this could cause excessive wing loads or a possible secondary stall.

Intentional spins are not permitted. If a spin should be entered accidently, use the following recovery procedures:

1. Close the throttles.

2. Neutralize ailerons.

3. Apply full rudder, opposing the direction of rotation.

4. Approximately one-half turn after applying rudder, push the control column forward (nose down).

5. Add power to the inside engine (inside with respect to the direction of the turn) if necessary to stop rotation. When rotation stops, neutralize rudders (close inside throttle if used).

6. Pull out of dive by exerting a smooth steady pressure on the controls.

8-41. Diving.

Maximum diving airspeed is 234 KIAS (red line). (Chapter 5). Flight characteristics are conventional throughout a dive maneuver; however, caution should be used if rough air is encountered after maximum allowable dive speed has been reached, since it is difficult to reduce speed in dive configuration. Dive recovery should be very gentle to avoid excessive aircraft stresses and discomfort to the passengers.

8-42. Maneuvering Flight.

Maneuvering flight within the category of acrobatics is prohibited. Normal maneuvers may be accomplished with moderate pilot effort. There are no conditions of normal maneuvering flight which will produce reversal of control pressures. The Flight Envelope Charts as shown in Chapter 5 are a plot of acceleration versus speed. These charts are prepared for maximum gross weight and show the speeds at which maneuvers are restricted and unrestricted, as related to load limit factors.

8-43. Flight Controls.

The aircraft is stable under all normal flight conditions. Aileron, elevator, rudder, and trim tab controls function normally throughout slow, cruising, and high speed flight. In general, controls become more sensitive as the speed increases and likewise, control forces become somewhat greater.

8-44. Flight Control Characteristics.

Additional control pressure at low airspeed is gained by the use of anti-servo trim tabs on the aileron and elevator. Extending and retracting the landing gear causes only slight changes in control pressure. The changes in control pressure which result from changes in power settings or the position of the wing flaps are easily manageable. Control forces produced by changes in speed, power setting, wing flap position, and landing gear position are light and can be overcome with one hand or reduced to zero by adjustment of the appropriate trim.

8-45. Level Flight Characteristics.

All flight characteristics are conventional throughout the level flight speed range.

Section V. ADVERSE ENVIRONMENTAL CONDITIONS

8-46. Introduction.

The purpose of this section is to inform the pilot of the special precautions and procedures to be followed during the various weather conditions that may be encountered in flight. This section is primarily narrative; only those check lists that cover specific procedures characteristic of weather operations are included. The checklist in Section II provides for adverse environmental operation.

8-47. Cold Weather Operation.

Difficulties encountered during operation in extremely cold weather result from not understanding the proper steps to be taken prior to and immediately after flight. It is important that all concerned with the operation be fully aware of the necessary procedures and precautions involved.

a. Preparation for Flight. Accumulations of snow, ice or frost on the surface of the aircraft can seriously affect takeoff distances, climb performance, and stall speeds to a dangerous degree. The ice and snow must be removed from the aircraft before flight to eliminate such effects in performance. (Refer to Chapter 2, Section XII). In addition to the normal exterior check inspect the leading edge and move the control surfaces to be sure they are free from ice after removal of all ice and snow. Check tires for proper inflation and see that they are not frozen to the ground or wheel chocks. Use ground heaters to free frozen tires. When heat is applied to release tires, the temperature should not exceed 160° F (71° C). In extreme emergencies, tires may be inflated to 1.5 times the normal pressure to free them, then reduced to normal pressure. Remove all covers and preheaters when possible. Open the oil drains to check for a free flow of oil. Apply heat if there is evidence of ice or if the oil is congealed. Pull propellers through at least three blades before starting. Use external power for starting and for engine warmup.

NOTE

A lighter grade engine oil is recommended for operation in temperatures below -12° C. In the event the lighter grade oil is not available and the aircraft is to be parked outside, the oil must be drained and stored in a warm place while the aircraft is parked.

NOTE

Prior to attempting a start at temperatures below -18° C, the engines and oil reservoirs must be preheated. Always use external power for preheat operations.

b. Engine Starting. Cold weather decreases the efficiency of the batteries and increases the viscosity of engine oil. Use an external power source for starting the engines. The primer should be used steadily until the engine starts, then intermittently but no more than necessary to support smooth engine operation. Close the throttle slightly from normal start position to reduce the possibility of backfiring. If the engine has not started after 45 seconds of continuous cranking allow the starter to cool for three minutes before attempting another start.

NOTE

As a result of increased oil viscosity, high or erroneously low indicated oil pressures may exist. In either case, operate engines at low RPM to allow warming and thinning of oil until normal pressures are achieved. If there is no oil pressure within 30 seconds after start or oil pressure drops below normal range after warming, shut down the engine.

c. Warm-up and Ground Tests. Generally, warmup procedures will be the same as those outlined in Section II, with the following exceptions:

1. Use carburetor heat to get better vaporization of fuel which will result in smoother ground operation at low power settings.

2. Move propeller lever forward and back to detent several times to insure warm oil supply to propeller and governor.

NOTE

In cold weather, make sure all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

d. Taxiing Instructions. Avoid taxiing through water or slush if possible. Water or slush splashed on the wing and tail surfaces will freeze, increase weight and drag and possibly limit control surface movement. Use induction system heat if necessary.

WARNING

Takeoff is not recommended when both the temperature and the dew point are in the area of -1° to +1°C (+30° +34°F) and the runway is wet or precipitation (rain or snow) is present. When the above conditions exist, ice may accumulate on the aircraft during runup and takeoff, and severe induction system icing may occur immediately after takeoff. Atmosphere containing free moisture is considered most favorable for induction system icing when free air temperatures are between -10° and +15°C (+14° to +59°F).

e. Before Takeoff. The engines should accelerate smoothly during runup with oil pressure normal and steady. Use induction system heat to remove any ice that may have collected, turn the pitot heat on just prior to takeoff and accomplish the BEFORE TAKEOFF CHECKS presented in Section II.

CAUTION

Carburetor air temperature above +74°C can result in material damage to the engine. Therefore, when using carburetor heat, make frequent checks to avoid exceeding temperature limits.

f. Takeoff. Takeoff procedures for cold weather operations are the same as for normal takeoff except that when operating in conditions of visible moisture (rain, sleet, fog, or snow) or when free air temperature is below +15°C, induction system heat should be used to maintain +55°C to 60°C carburetor air temperature. After engine checks and just prior to takeoff, set the engines at 2600 RPM (propeller controls in LOW PITCH position) and apply carburetor heat. Leave the carburetor heat handles in this position during takeoff and initial climb. These settings will normally maintain carburetor air temperatures within safe operating limits.

g. During Flight. Use induction system heat as required to prevent icing and to assist in maintaining normal engine operations. Cycle the propellers periodically to maintain a supply of warm oil in the propeller hubs, thus preventing the oil from congealing. Pitot heat should be used when visible moisture is present. Trim tabs and controls should also be exercised periodically to prevent freezing.

NOTE

Use carburetor heat before icing becomes critical. If the ice formation is allowed to progress to a critical point, the loss of engine power may make it impossible for the engine to generate enough heat to melt the ice.

h. Descent. Use power during descent to prevent engine overcooling. If overcooling becomes a problem, make a gradual descent within landing gear and wing flap operating speed, and lower the landing gear and wing flaps. Increase power and use induction system heat as necessary to maintain carburetor air temperatures within safe operating limits.

i. Landing.

CAUTION

Monitor carburetor heat when advancing throttles for go-around or any emergency requiring high power application.

In addition to the procedures prescribed in Section II for landing, observe engine temperatures closely. Maintain sufficient power to keep cylinder head temperatures above operating minimum. Induction system heat may be used to insure proper fuel vaporization. Use brakes sparingly or only when necessary during landing roll.

NOTE

During approach or when operating at low altitudes when heavy icing conditions are present, higher than normal airspeeds should be maintained in order to compensate for the additional weight imposed on the wing and tail surfaces due to ice formations.

j. Engine Shutdown. Follow normal engine shutdown procedures outlined in Section II.

k. Before Leaving Aircraft. Park the aircraft in a warm area if possible. Should this be impossible; after the wheel chocks are in place, release the parking brakes to prevent freezing, and lock the control surfaces. Drain condensate from fuel tank drains before the moisture in them freezes. If the fuel tanks are kept filled, condensation in fuel lines and drains will be minimized. Inspect vents and crankcase breathers and remove any existing ice. Clean the landing gear shock struts of dirt and ice. Install protective covers to guard against possible collection of snow and ice. If the aircraft is to remain outside in freezing temperatures for a period of more than 4 hours, have the batteries removed and the oil drained if required.

8-48. Desert Operation.

Dust and sand and high temperatures encountered during desert operation can sharply reduce the operational life of the aircraft and its equipment. The abrasive qualities of dust and sand upon cylinder walls, valves, and moving parts of the aircraft and the destructive effect of heat upon the aircraft instruments will necessitate hours of maintenance if certain basic preventive measures are not followed. In flight, the hazards of dust and sand will be difficult to escape, since dust clouds over a desert may be found at altitudes up to 10,000 feet.

a. Preparation for Flight. Check the position of the aircraft in relation to other aircraft. Sand blown by operating engines can damage other aircraft. Wipe the shock struts free of dust and sand with a clean cloth. Remove all aircraft protective covers. Check instrument panel and general interior for dust and sand accumulation. Open cabin door and windows to ventilate the aircraft. Operate all moveable control surfaces.

b. Engine Starting. Use normal procedure outlined in Section II.

c. Warm-Up and Ground Tests. Perform the normal procedures outlined in Section II. Minimize ground operating time to maintain engine operating temperatures within limits.

d. Taxiing. Use minimum power settings and minimum wheel braking action since both engine and wheel brake cooling is a problem under high ambient air temperatures.

e. Takeoff. No special technique or procedures are required during takeoff.

f. During Flight. No special technique or procedures are required during flight operation.

g. Descent. No special technique or procedures are required during descent.

h. Landing. No special technique or procedures are required during landing.

i. Engine Shutdown. Shut down the engines as soon as possible to avoid excessive temperature rises. Refer to Section II for normal engine shutdown procedure.

j. Before Leaving Aircraft. Install all protective covers to keep out blowing sand and dust. If blowing sand and dust do not present a hazard, leave cabin windows open to provide ventilation. Take extreme care to prevent sand or dust from entering the fuel or oil tanks during servicing.

8-49. Hot Weather Operation.

During hot weather operations, the principal difficulties encountered are inadequate engine cooling (especially during ground operation), overheating of brakes, and longer takeoff and landing rolls due to the less dense hot air. In areas where high humidity is encountered, electrical

equipment such as communication equipment and instruments will be subject to malfunction by corrosion, fungi, and moisture absorption by nonmetallic materials.

a. Preparation for Flight. Check the aircraft thoroughly for any evidence of dust, sand, and fungi. Clean all parts where possible damage could result from these accumulations. Use a cloth moistened with hydraulic fluids to wipe the shock struts clean. Remove the engine cover and/or other protective covering.

b. Engine Starting. Avoid overpriming. If the engine has not started after 45 seconds of cranking, allow starter to cool before attempting another start. Refer to Section II for normal starting procedure.

c. Warm-Up and Ground Tests. Keep engine ground operation time to a minimum. Ground checks should be complete, but accomplished as quickly as possible to prevent engine operating temperatures from exceeding the limits.

d. Taxiing. Use the wheel brakes as little as possible since cooling is retarded at high ambient temperatures.

e. Takeoff. No special technique or procedures are required during takeoff.

f. During Flight. No special technique or procedures are required during normal flight operation.

g. Descent. No special technique or procedures are required during descent.

h. Landing. No special technique or procedures are required during landing.

i. Engine Shutdown. Shut down the engines as soon as possible to avoid excessive temperature rises. Refer to Section II for normal engine shutdown procedure.

CAUTION

If fuel tanks are completely filled, fuel expansion may cause overflow, thereby creating a fire hazard.

j. Before Leaving Aircraft. Install wheel chocks and release the wheel brakes immediately to prevent warpage of the brake discs. Leave windows and doors open as necessary for ventilation.

WARNING

Due to the comparatively light weight of the U-8 series aircraft, control in severe turbulence and moderately heavy thunderstorms is critical. Since turbulence imposes heavy loads on the aircraft structures, make all necessary changes in aircraft attitude with the least amount of control pressures to avoid excessive loads on the aircraft's structure.

8-50. Turbulence and Thunderstorm Operation.

Plan the flight to avoid areas of severe turbulence and thunderstorms if possible. During night or instrument flight conditions it is not always possible to detect individual storm areas of find the in-between clear areas. If such turbulence is penetrated, it will be necessary to counter rapid changes in attitude and accept major indicated altitude variations.

NOTE

Do not lower landing gear or wing flaps as they merely decrease the aerodynamic efficiency of the aircraft.

8-51. Penetration.

At gross weights of 6000 lbs or above, the recommended penetration speed for severe turbulence is normal cruise speed (145 KIAS). Pitch attitude and constant power settings are vital to proper flight technique. Establish recommended penetration speed and proper attitude prior to entering turbulent air to minimize most difficulties. False indications by the pressure instruments due to barometric pressure variations within the storm make them unreliable. Maintaining a pre-established attitude will result in a fairly constant airspeed. Complete the following procedures when there is a possibility of encountering turbulent air or thunderstorm activity:

1. Establish penetration airspeed.
2. Secure loose equipment.
3. No smoking.
4. Fasten seat belts.

5. Turn cabin lights on to minimize the blinding effect of lightning.

6. Turn on pitot heat when visible moisture is encountered.

7. Check flight instruments for proper indication.

8. Advise personnel of approach to storm.

9. Maintain constant power settings and pitch attitude regardless of airspeed or altitude indications. Concentrate on maintaining a level attitude by reference to the attitude indicator.

NOTE

If possible, adjust to the desired power setting prior to entering a storm area. The important factor is to keep engine operations within limitations. Usually this can best be accomplished by not changing the throttles and propeller controls after establishing an appropriate power setting.

10. Maintain original heading. Make no turns unless absolutely necessary.

11. Do not chase the airspeed indicator; doing so will only result in extreme variations of aircraft attitude and the possibility of exceeding safe airspeed. Barometric pressure variations may also cause extreme fluctuations of indicated airspeed.

12. Apply as little pressure as possible on the control surfaces to prevent excessive strains on the aircraft structure.

13. The gain or loss of several thousand feet of indicated altitude may be expected, due to the unstable barometric pressure. Allowance should be made in determining minimum safe altitude.

NOTE

Altitudes between 10,000 and 20,000 feet are normally the most turbulent areas. The best penetration altitude is usually 6000 feet AGL.

CAUTION

No deicing provisions exist for the dipole antennas on RU-8D. Flight into known icing conditions should be avoided.

8-52. Ice and Rain.

Flights through ice and rain may present additional problems and should be avoided if possible. However, if flight in these conditions is necessary, proper use of the preventive and remedial equipment should minimize the problems encountered. The aircraft is equipped with anti-icing and deicing systems to prevent the formation of ice on the propellers and pitot. At any time visible moisture is present, use pitot heat. Deicer boots are provided to remove ice from the wing and tail leading edges. Windshield defrosters are installed to alleviate conditions resulting from rain, frost, or light ice. Alternate air provides protection against induction system icing. No equipment is provided to prevent ice from forming on the nacelle air intake scoops; therefore, flights of long duration should not be attempted in severe icing conditions. If severe icing conditions are encountered, ascend or descend to an altitude where such conditions do not prevail. Operation of the ice removal and preventive equipment discussed herein is described in Chapter 2.

a. Icing. Icing occurs because of supercooled water in visible moisture such as fog, clouds, or rain. The most severe type of ice formation will generally occur at a temperature of approximately -5° C.

b. Taxiing. Extreme care must be exercised when taxiing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

c. Takeoff. If icing conditions are anticipated during takeoff, turn on the anti-icing systems.

d. Climb. Climb at 10 to 15 KIAS above normal climb speeds when icing conditions exist. Reducing the angle of attack minimizes the accumulation of ice on all surfaces.

e. Cruising Flight. Prevention of ice formation is far more effective and satisfactory than attempts to dislodge the ice after it has formed. If icing conditions are anticipated turn on the anti-icing systems prior to penetration. Refer to Chapter 2 for use of deicer boots.

NOTE

Do not operate deicer boots continuously. Continuous operation tends to balloon the ice over the boots. Allow the ice to build up to approximately 1/2 inch thick, then turn deicer boots on to remove the ice, then turn deicer boots off. Repeat this procedure as often as necessary.

NOTE

Do not operate cabin heater when icing conditions are severe enough to cause blockage of the cabin heater air intake duct. Operation of the cabin heater when the air intake is blocked with ice will cause the heater to overheat and the heater fuse to blow.

f. Landing. Extreme care must be exercised when landing on ice or slippery runways. Excessive use of either brakes or power may result in an uncontrollable skid.

NOTE

Ice accumulation on the aircraft will result in higher stalling airspeeds due to the change in aerodynamic characteristics and increased weight of the aircraft due to ice buildup. Approach and landing airspeeds must be increased accordingly.

Section VI. CREW DUTIES

8-53. Crew/Passenger Briefing.

The following is a guide that should be used in accomplishing required passenger briefings, when a unit passenger briefing is not available. Items that do not pertain to a specific mission may be omitted.

a. Crew Introduction.

b. Equipment.

1. Personal to include ID tags.
2. Professional.
3. Survival.

c. Flight Data.

1. Route.
2. Altitude.
3. Time enroute.
4. Weather.

d. Normal Procedures.

1. Entry and exit of aircraft.
2. Seating.
3. Seat belts.
4. Movement in aircraft.
5. Internal communications.
6. Security of equipment.
7. Smoking.
8. Oxygen.
9. Refueling.
10. Weapons.
11. Protective masks.
12. Parachutes.

e. Emergency Procedures.

1. Emergency exits.
2. Emergency equipment.
3. Emergency landing/ditching procedures.
4. Bail out.

CHAPTER 9
EMERGENCY PROCEDURES

Section I. AIRCRAFT SYSTEMS

9-1. Aircraft Systems.

This section describes the aircraft systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the Operator's and Crewmember's Checklist, TM 55-1510-201-CL/4. Emergency operations of avionics equipment are covered when appropriate in Chapter 3, Avionics.

9-2. Immediate Action Emergency Checks.

Those checks that must be performed immediately in an emergency procedure are underlined. Those immediate action emergency checks must be committed to memory.

NOTE

The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is aircraft control. All procedures are subordinate to this requirement.

9-3. Emergency Exits and Equipment.

WARNING

The center side windows shall never be opened in flight. Under no circumstances shall a bailout be attempted through the windows. On the RU-8D, the right center exit window may be used for emergency exit.

a. Emergency Exits. U-8D RU-8D The entrance door and two center windows (figure 9-1) provide emergency escape routes from the aircraft either on the ground or when ditching. The door may be jettisoned for bailout. Escape from the rear seat through the entrance door requires tilting of the right front seat, which is normally locked in position when the door is closed. Opening the door releases the seat lock; however, when the door is jettisoned, the lock must be released from the rear seat by pulling the emergency seat release handle at the back of the right front seat, near the floor.

WARNING

The center side windows shall never be opened in flight. Under no circumstances shall a bailout be attempted through the windows.

b. Emergency Exits. U-8G The entrance doors and two center windows provide emergency escape routes from the aircraft either on the ground or when ditching (figure 9-2).

9-4. Emergency Entrance.

Emergency entrance may be gained by opening the cabin entrance door. If the door is jammed, the center windows may either be broken with a fire axe to gain access to the window release pins or cut out along the dotted lines stenciled CUT HERE FOR EMERGENCY RESCUE. No release provisions are incorporated in the front windows.

9-5. Engine.

a. Flight Characteristics Under Partial Power Conditions. Single-engine operations due to engine failure are sometimes preceded by symptoms which enable you to take preventive action if you are alert to operating conditions at all times. Complete engine failure most often occurs due to fuel starvation. This type of emergency is seldom due to mechanical causes; however, failure due to carelessness or improper operating techniques is not uncommon and may be avoided by constant attention to cylinder head temperatures, fuel and oil pressures and temperatures, sound of engines, manifold pressure, and RPM. These operating limitations are established and discussed in Chapter 5. If an engine malfunction is indicated, land as soon as practicable. It is essential to have a thorough understanding of the principles affecting single-engine performance and the limitations resulting from the unbalance of power. Two principal factors govern flight safety on one

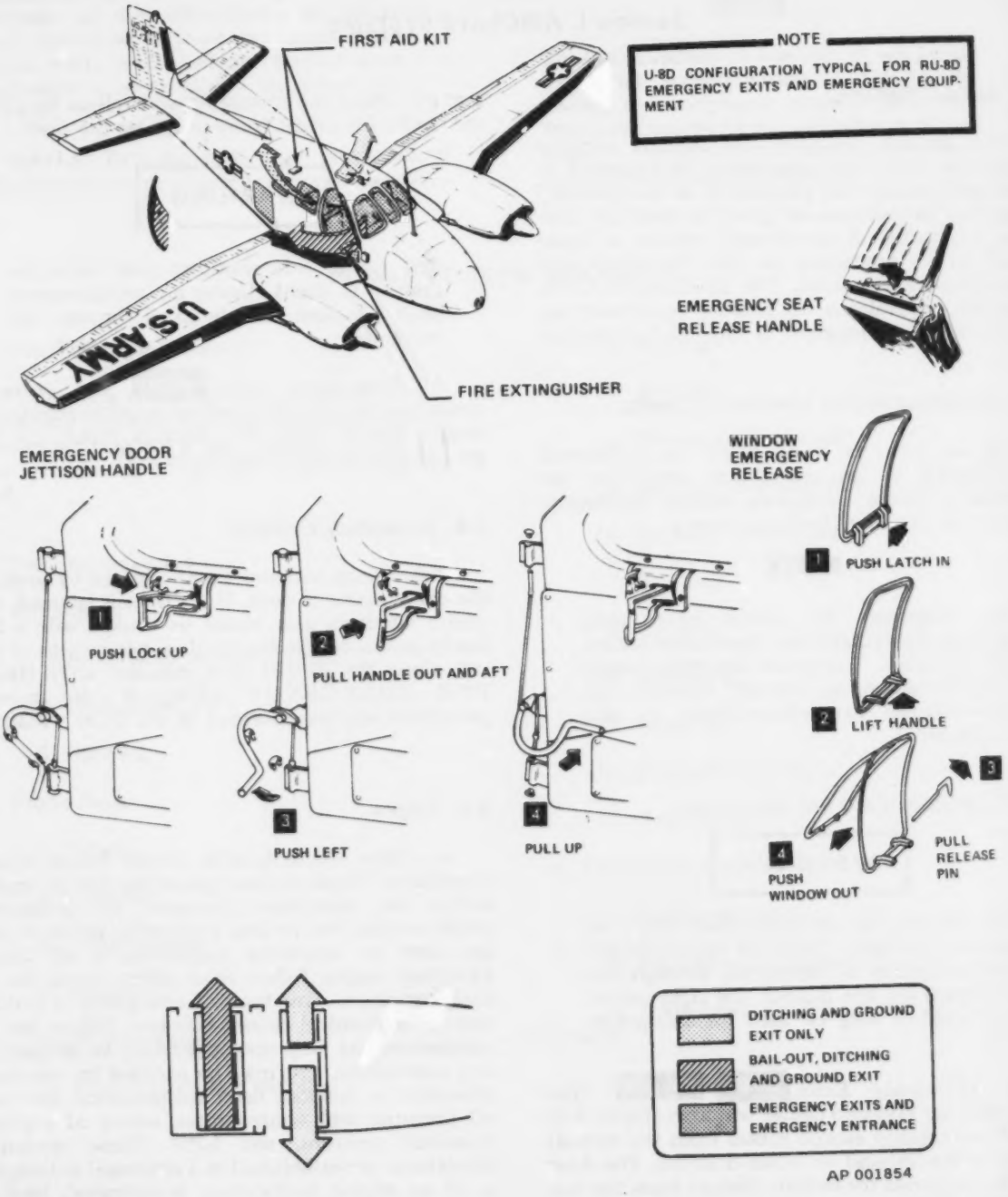


Figure 9-1. Emergency Exits and Equipment U - 8D RU - 8D

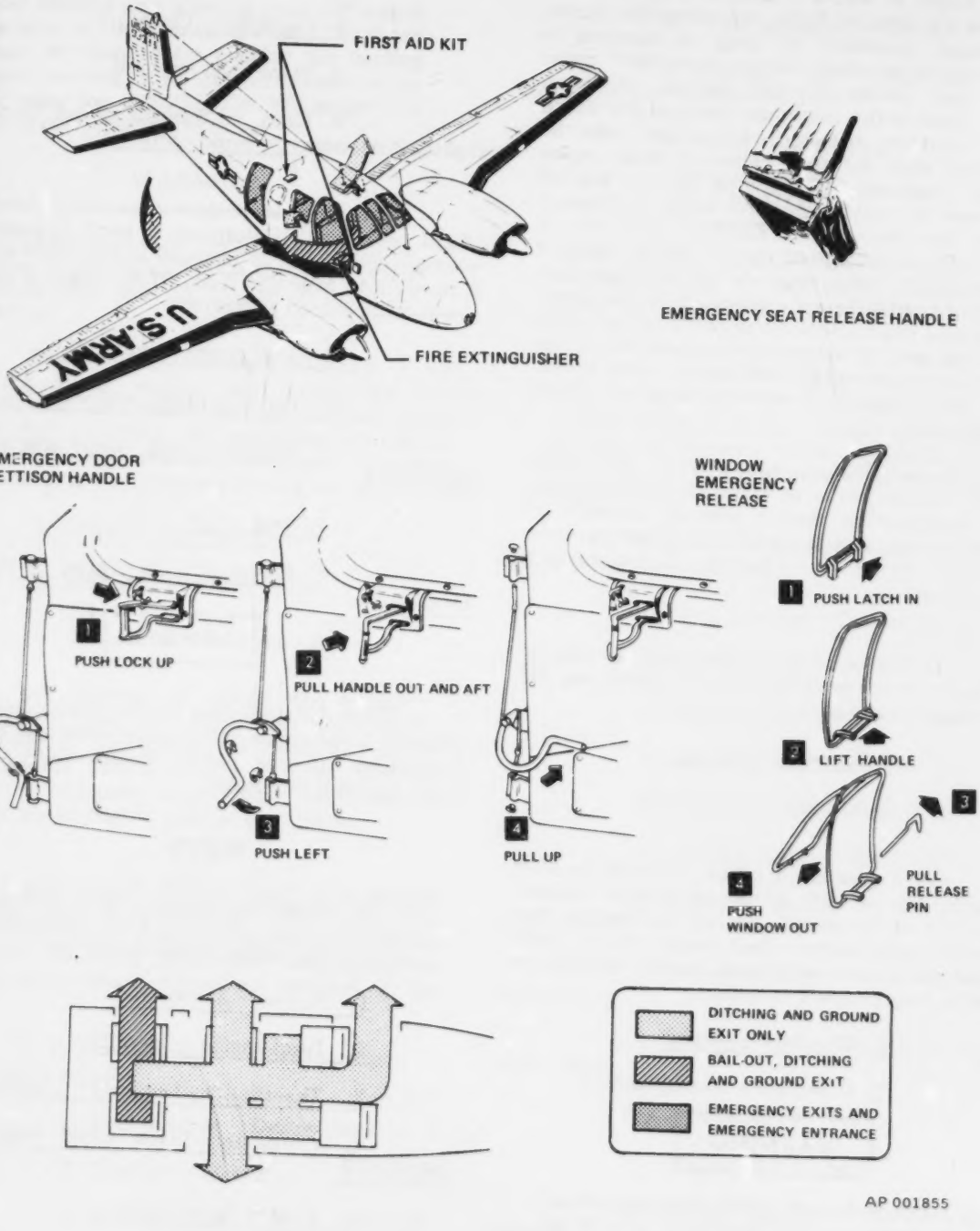


Figure 9-2. Emergency Exits and Equipment U-8G

engine: AIRSPEED and POWER; directional control being in direct proportion to airspeed. There are no unusual flight characteristics during single-engine operation as long as airspeed is maintained at or above minimum control speed (Vmc) and power-off stall speeds. Minimum control speed is the minimum airspeed for which lateral and/or directional control can be maintained with the flaps retracted, dead engine propeller feathered, live engine set to takeoff power and 5° maximum bank angle maintained towards the live engine (landing gear UP or DOWN). The capability of the aircraft to climb or maintain level flight depends on configuration, gross weight, altitude and outside air temperature. Performance and control will improve by retracting the landing gear (if extended) and establishing the appropriate single-engine best rate-of-climb speed. Refer to Chapter 7 for single-engine climb performance.

b. Engine Malfunction During and After Takeoff. The action to be taken in the event of an engine malfunction during takeoff depends on whether or not takeoff speed of 95 KIAS has been attained. Refer to Chapter 7 for takeoff performance.

(1) Engine malfunction during takeoff run (abort). In all cases regardless of speed, use the following procedures:

1. Throttles — Closed.
2. Braking — As required.

(2) Engine malfunction immediately after takeoff below 95 KIAS (sufficient runway remaining). If the aircraft has left the ground, but minimum single-engine climb speed has not been reached and there is sufficient runway available in which to stop, proceed as follows:

1. Throttles — Closed.
2. Complete a normal landing.

WARNING

A controlled crash landing straight ahead is preferable to the likelihood of stall or loss of control.

(3) Engine malfunction immediately after takeoff below 95 KIAS (insufficient runway remaining). If sufficient runway is not available in which to land the aircraft and minimum single-engine climb speed has not been attained, avoid a stall and proceed as follows:

1. Throttles — Closed.
2. Flaps — As required.
3. Land — Straight ahead turning slightly if necessary to avoid obstacles.

(4) Engine malfunction after takeoff (flight continued). Determine as early as possible whether conditions of airspeed and altitude make it possible to maintain flight. If the flight is to be continued, proceed as follows:

1. Dead engine — Identify.
2. Throttle (dead engine) — Closed.
3. Propeller lever (dead engine) — FEATHER.
4. Gear — UP.
5. Flaps — UP (after obstacles cleared).
6. Airspeed — 95 KIAS.

c. Engine Malfunction During Flight. Refer to Chapter 7 for cruise information with one engine inoperative. If one engine malfunctions during flight, proceed as follows:

NOTE

If the situation permits, retard throttle analyze the malfunction and take appropriate action to restore power.

1. Power — As required.
2. Dead engine — Identify.
3. Throttle (dead engine) — Closed.
4. Propeller lever (dead engine) — FEATHER.
5. Gear — As required.
6. Flaps — As required.
7. Power — As required.
8. Fuel selectors — As required.

NOTE

The landing gear warning horn will sound as soon as the throttle is closed. The horn may be silenced by pushing the landing gear warning horn silencer button or by opening the throttle after the engine has been completely shut down.

WARNING

Altitude cannot be maintained under all gross weight conditions with one propeller windmilling and full power on the good engine.

d. Engine Malfunction During Final Approach. If an engine fails during the final approach of a normal landing pattern (after LANDING CHECK) the propeller should be feathered if time and altitude permit. Continue approach using the following procedure:

1. Power — As required.
2. Gear — Recheck DOWN.

CAUTION

Do not attempt to restart the engine unless it can be determined that no damage to the engine will result and no additional hazard will be created. If in doubt, continue single-engine flight and land the aircraft as soon as practicable.

e. Engine Restart During Flight. If it appears reasonably safe to attempt an airstart after the cause of the failure has been determined, use the applicable following procedure (depending on whether accumulators have been installed on the aircraft):

(1) Engine restart during flight — accumulators installed.

1. Fuel selector — Desired tank.
2. Throttle — Closed.
3. Mixture lever — IDLE CUTOFF.
4. Propeller lever — LOW PITCH until propeller windmills, then back to detent.
5. Mixture lever (RPM stabilized) — RICH.
6. Oil pressure — Check.
7. Fuel pressure — Check.
8. Warmup — 18 - 20 in. Hg. (until oil temperature reaches 38°C).
9. Power — As required.

CAUTION

If the starter fails to crank the engine, internal failure is indicated; therefore, make no further starting attempt.

CAUTION

If the engine has not started after 45 seconds of cranking, allow the starter to cool for 3 minutes before attempting another start.

(2) Engine restart during flight — accumulators not installed.

1. Fuel selector — Desired tank.
2. Boost pump — ON.
3. Right magneto switch — OFF.
4. Propeller lever — Detent.
5. Throttle — One fourth open.
6. Mixture lever — IDLE CUTOFF.
7. Starter button — Press until engine starts.
8. Primer button — Press. Prime as necessary.
9. Mixture lever — RICH when engine fires.
10. Right magneto — ON.
11. Oil pressure — Check.
12. Boost pump — OFF, check pressure.
13. Warmup — 18 - 20 in. Hg. (until oil temperature reaches 30°C and cylinder head temperature 121°C).
14. Power — As required.

WARNING

It is possible to fly for several hours having a suspected fuel leak and no evidence of fire, therby creating a false sense of security. This condition may be due to the air flow, with its cooling and dispersing effect, serving to prevent an outbreak, and it is only when throttles are retarded and the airspeed reduced that the airflow characteristics change and a fire develops. For this reason, the engine must be run at the same settings until no longer required, then shut down completely by shutting off the fuel and then feathering the propeller after the engine stops.

f. Fuel Pressure Drop — Engine Operating Normally. If the fuel pressure drops below normal operating limits, and the engine continues to function normally, make a visual check of the affected side for the presence of streaming fuel vapor or signs of fire. If the cause of the pressure drop cannot be determined and no evidence of a fuel leak exists, maintain the watch for fire and shut down the engine completely before entering the landing pattern. Should there be positive evidence of a fuel leak, shut down the engine immediately and land as soon as practicable.

NOTE

Do not feather both propellers unless absolutely unable to obtain power from either engine.

g. Maximum Glide. In the event of failure of both engines, maximum gliding distance can be obtained by feathering both propellers to reduce propeller drag and by maintaining glide airspeed, with landing gear and wing flaps up. Turn off all electrical equipment to conserve battery power for lowering landing gear and wing flaps, but leaving battery master and lock switches ON. Approximate gliding distances in relation to altitude are given in figure 9-3 or 9-4.

CAUTION

On U-8D aircraft, when the right engine is inoperative, the entrance step circuit breaker should be pulled to prevent the step from extending after landing.

h. Landing With One or More Engines Inoperative.

NOTE

With full flaps and gear down, level flight cannot be maintained on one engine.

(1) Single-engine landing. Fly a normal pattern and perform BEFORE LANDING checks as appropriate. Extend flaps only after there is no possibility of a go-around. If altitude cannot be maintained while maneuvering for landing, the landing gear and flaps should be retracted, then lowered and checked down when landing is assured. Do not extend full-flaps until gear is down and locked. Make a normal touchdown, reducing power during flareout. Avoid excessive or abrupt changes in power. A feathered propeller will result in less drag and may cause the aircraft to "float" during landing. After touchdown, apply brakes as required.

(2) Forced landing — no power. If sufficient altitude remains after reaching a suitable landing area, a circular descent over the field will provide best observation of ground conditions, wind velocity, and direction. When the condition of the terrain has been noted and landing area picked, set up a rectangular pattern and lower the landing gear on the downwind leg. Fly the base leg as necessary to control point of touchdown. Plan to overshoot rather than undershoot, using wing flaps as necessary. In event positive gear indication cannot be determined, prepare for a gear-up landing. Refer to paragraph 9-11.

(3) Single-engine descent-arrival check. Perform the following checks prior to traffic pattern entry:

1. Seat belts and shoulder harnesses — Secure (crew/passengers checked).
2. Fuel control panel — Check.
3. Carburetor heat — As required.
4. Landing/taxi lights — As required.

(O) 5. Step motor circuit breaker — Pull.

(4) Single-engine before landing check. Perform the following checks upon pattern entry:

1. Carburetor heat — As required.

(O) 2. Doppler navigation system — OFF.

3. Gear — DOWN.

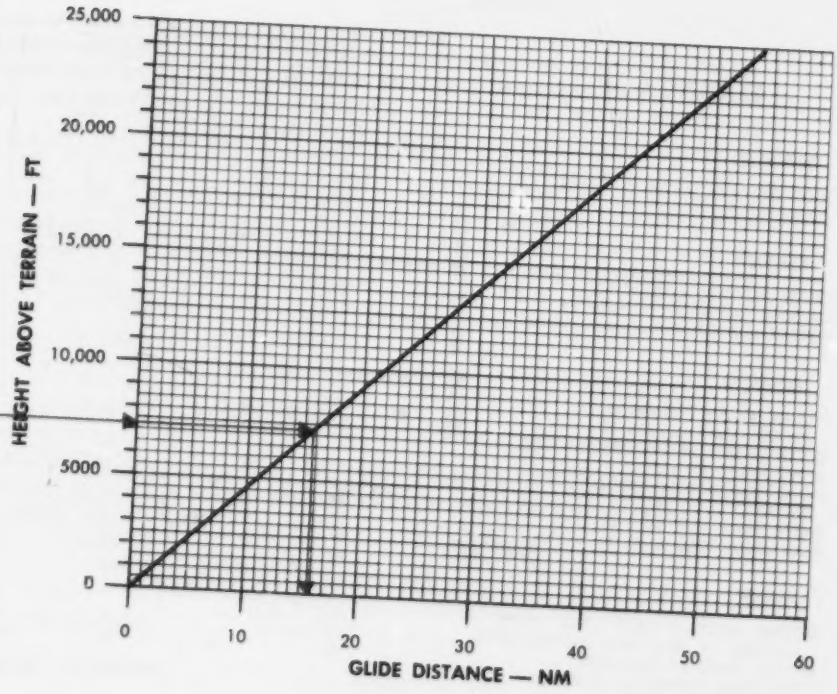
GREEN

MAXIMUM GLIDE DISTANCE

FLAPS 0 DEGREES PROPS FEATHERED GEAR UP

MAXIMUM GLIDE DISTANCE
U-8D, U-8G
O-480-1

WEIGHT — LB	IAS — KT
7000	106
6500	102
6000	98
5500	93
5200	91



EXAMPLE

WANTED

GLIDE DISTANCE AVAILABLE AND GLIDE SPEED TO USE

KNOWN

CRUISE ALTITUDE = 12,000 FT
GROUND ELEVATION = 4664 FT
WEIGHT = 6250 LB

METHOD

HEIGHT ABOVE TERRAIN = 12,000 − 4664 = 7336 FT
ENTER HEIGHT ABOVE TERRAIN HERE
MOVE RIGHT TO LINE
MOVE DOWN, READ GLIDE DISTANCE = 15.8 NM
ENTER TABLE FOR 6250 LB
READ GLIDE IAS = 100 KT

NOTE

EXTEND LANDING GEAR ONLY WHEN ASSURED OF REACHING LANDING SITE. EXTEND FLAPS AS REQUIRED. ELECTRICAL POWER IS REQUIRED TO EXTEND FLAPS.

REMARKS

GLIDE DISTANCE RELATIVE TO HEIGHT ABOVE TERRAIN AND GLIDE AIRSPEED RELATIVE TO AIRCRAFT WEIGHT ARE SHOWN.

AP 001869

Figure 9-3. Maximum Glide Distance U-8D U-8G

GREEN

MAXIMUM GLIDE D'STANCE
FLAPS 0 DEGREES PROPS FEATHERED GEAR UP

MAXIMUM GLIDE DISTANCE
RU-8D
O-480-1

WEIGHT — LB	BEST GLIDE SPEED IAS - KT
7000	98
6500	94
6000	90
5500	86
5200	84

EXAMPLE

WANTED

GLIDE DISTANCE AVAILABLE AND GLIDE SPEED TO USE

KNOWN

CRUISE ALTITUDE = 2000 FT
GROUND ELEVATION = 4664 FT
WEIGHT = 6110 LB

METHOD

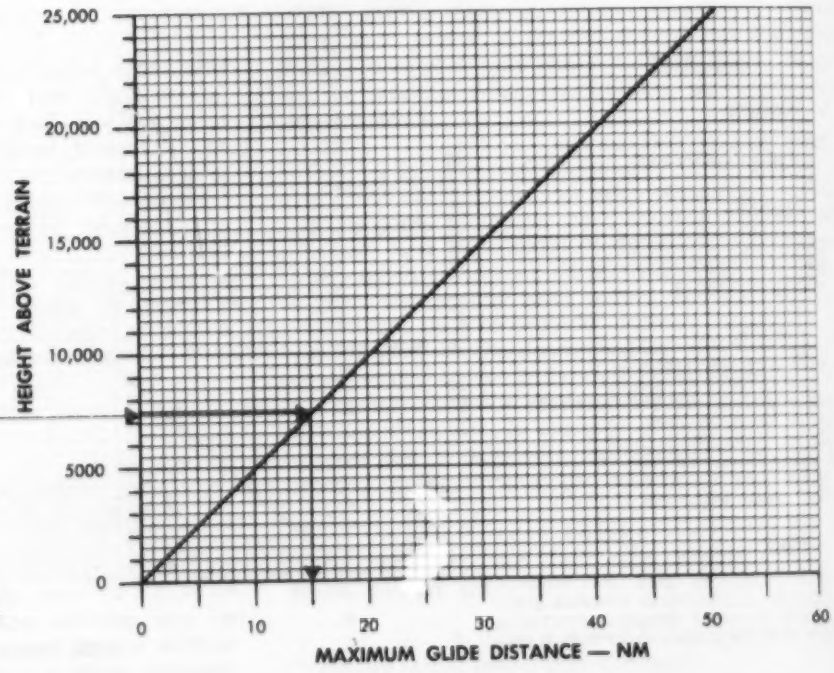
HEIGHT ABOVE TERRAIN = 12,000 − 4664 = 7336 FT
ENTER HEIGHT ABOVE TERRAIN HERE
MOVE RIGHT TO LINE
MOVE DOWN, READ GLIDE DISTANCE = 15 NM
ENTER TABLE FOR 6110 LB
READ GLIDE KIAS = 91 KT

NOTE

EXTEND LANDING GEAR ONLY WHEN ASSURED OF REACHING LANDING SITE
EXTEND FLAPS AS REQUIRED.
ELECTRICAL POWER IS REQUIRED TO EXTEND FLAPS

REMARKS

GLIDE DISTANCE RELATIVE TO HEIGHT ABOVE TERRAIN AND GLIDE AIRSPEED RELATIVE TO AIRCRAFT WEIGHT ARE SHOWN.



DATA BASIS: DERIVED FROM FLIGHT TEST

AP 001996

Figure 9-4. Maximum Glide Distance RU-8D

4. Landing lights — ON.

(5) Single-engine landing check. Perform the following checks before landing:

1. Gear — Recheck DOWN (check lights).

2. Propeller (live engine) — As required.

i. Single-Engine Go-Around (One Engine Inoperative). The decision to go-around must be made as early as possible, since the conditions governing any single-engine go-around are extremely critical. Gain airspeed before climbing. Climb out at or above 95 KIAS using maximum allowable power. To perform a single-engine go-around, proceed as follows:

NOTE

Once the flaps are fully extended on a single-engine final approach the aircraft is committed to land and a go-around should not be attempted.

NOTE

Elevator control forces at the start of a go-around are very high; retrim as time permits. An extreme amount of rudder control will be required at low airspeeds. If insufficient control is applied, or applied too slowly, directional control cannot be maintained.

1. Power — Maximum controllable (correct for yaw as necessary).

2. Gear — UP.

3. Flaps — UP.

4. Carburetor heat — As required.

5. Landing/taxi lights — As required.

6. Climb power — Set.

7. Boost pump — OFF.

j. Chip Detector Warning Light — ON. The illumination of either chip detector light will require the following immediate procedures:

1. Engine instruments — Monitor.

2. Land as soon as practicable.

9-6. Propeller Overspeed.

In the event of an uncontrolled overspeed condition, proceed as follows:

1. Airspeed — Reduce (increase pitch attitude).

2. Power — Reduce.

3. Propeller lever (faulty prop) — Retard to detent.

NOTE

If control is not regained by moving propeller lever through full range of travel or RPM cannot be maintained below maximum limits by the above procedure, shutdown the engine and feather the propeller. (The possibility of a broken cable connection at the propeller governor must be considered at this time.) If the propeller fails to feather, restart the engine and use maximum power without exceeding RPM limits. Maintain 105 to 110 KIAS and land as soon as practicable.

9-7. Fire.

a. Engine Fire. The following paragraphs indicate action to be taken in case of fire.

NOTE

Engine fire extinguisher systems are not installed.

(1) Engine/nacelle fire during start or ground operation. In the event of an engine fire during starting or ground operation, attempt to keep the engine running to extinguish the fire, if possible. If the engine has not started, keep it cranking with the starter. If this fails, proceed as follows:

1. Mixture levers — Idle cutoff.

2. Throttles — Close.

3. Magneto switches — OFF.

4. Fuel selectors — OFF.

5. Oil shutoff handles — Out.

6. Abandon aircraft and use fire extinguisher.

NOTE

If fire extinguishers are used on the engine, do not attempt a restart until the cause has been determined and corrected and all fire extinguishing agents removed.

WARNING

Failure to promptly comply with the engine shutdown procedures can result in an uncontrollable wheel well fire and wing separation.

(2) Engine fire during flight. In the event of an engine fire during flight, and no means of extinguishing it seems feasible, shut down the affected engine as follows:

1. Fuel selector and boost pump — OFF.
2. Mixture lever — Idle cutoff.
3. Propeller lever — FEATHER.
4. Oil shutoff handle — Out.

WARNING

Repeated or prolonged exposure to high concentrations of monobromotrifluoromethane (CF_3Br) or decomposition products should be avoided. The liquid should not be allowed to come in contact with the skin, as it may cause frost bite or low temperature burn because of its very low boiling point.

b. Fuselage Fire. Most fuselage fires can be reached with the portable cabin fire extinguisher. Keep all windows and entrance door closed and shut off heating and ventilating system to keep drafts to a minimum. When any fuselage fire occurs, perform the following:

(O) 1. Oxygen — On.

2. Cockpit air shutoff control — Full out (shutting off ventilating air supply).

3. Heater blower switch — OFF.

4. Fight the fire immediately with all available fire extinguishing equipment.

5. If fire cannot be extinguished — Land immediately and evacuate the aircraft.

c. Wing Fire. There is little that can be done in controlling a wing fire except to shut off fuel and electrical systems that may be contributing t the fire. Slipping the aircraft away from th burning wing may help and will assist in losing altitude quickly.

NOTE

Land the aircraft immediately or bail out, depending on circumstances and seriousness of the fire.

d. Electrical Fire. All circuits except starter and relays are protected by circuit breakers, which tend to prevent an electrical fire. Upon noting the existence of an electrical fire, immediately turn off all affected electrical circuits, if known. If electrical fire source is unknown, proceed as follows:

1. Master switch — Down.
2. All electrical switches — OFF.
3. Battery — On.
4. Generators — On.
5. Essential equipment — O (individually until fire source is isolated).

NOTE

With battery switch and generator switches turned OFF, landing gear, wing flap, and boost pump circuits will be inoperative. If deemed reasonably safe, turn BAT switch or generator switch on long enough to lower the landing gear and then turn OFF again. Otherwise, lower the landing gear manually and land with the wing flaps up.

CAUTION

Do not jettison the cabin door unless a bailout is definitely contemplated, and never open the center windows in flight as they may be torn off.

e. Smoke and Fume Elimination. Aft making sure that the fire is out and will not b aggravated by draft, check that the heater circui breaker switch is OFF, to prevent possible fir hazard from heater, and push cockpit air shuto controls full in to admit ventilating air from th

nose air intake. Open the pilot's storm window. If smoke and fumes remain dense enough to impair safe operation of the aircraft, unlock the entrance door (safety chain hooked on U-8G aircraft).

9-8. Fuel System.

a. Fuel System Emergencies. Failure of an engine-driven fuel pump will result in loss of fuel pressure, followed by engine failure. Fuel pressure may be maintained with boost pumps, located in the main tanks and auxiliary tanks, unless another malfunction exists or is suspected, which might create a fire hazard. In any event, the best policy is to land as soon as practicable and remedy the malfunction.

b. Fuel System Single-Engine Operation. With one engine inoperative, fuel from its main tank may be used by placing the fuel selector valve handle of the operating engine in CROSSFEED position. Although the engine will normally operate satisfactorily from crossfeed, boost pumps in the tank supplying the engine may be turned on to supplement the engine driven pump. The auxiliary tanks are not provided with a crossfeed system.

9-9. Electrical System.

a Electrical System Failure. In the event both generators and batteries are shut off, boost pumps and wing flaps will be inoperative and landing gear must be lowered manually. Warning horns, indicator lights, turn-and-slip indicator, oil temperature and fuel quantity gages, electrically operated gyro instruments, and radio navigation instruments will be inoperative. Suction for the copilot's attitude indicator is normally available as long as one engine is operating.

b. Generator Failure. Either generator is apable of carrying the full load of normal lectrical equipment. However, loss of either ngine causes a partial failure of the electrical ower supply system, and nonessential electrical uipment should be used judiciously to avoid erloading the remaining generator. Loads in cess of single generator output will drain tteries with the resultant loss of reserve and ergency power. Choice of equipment to use will determined by conditions and the relative rrent load imposed by various operating ipment, such as radios, heater, and accessories h as cigarette lighter, which creates a very high n. Should both generators be shut off, all essential equipment should be turned off to erve battery power for lowering of the landing gear and wing flaps. If generator failure is suspected use the following procedures:

(1) One generator out. The following actions will be taken when a zero reading is indicated on the ammeter with a higher than normal reading on the opposite ammeter.

1. High operating generator — OFF.

2. Zero ammeter and voltmeter — Check. An increase on the ammeter and approximately 28 volts indicate that the generator is operating. Turn the opposite generator back on and continue the flight on both generators. No increase on the ammeter and approximately 24 volts indicates that the generator is inoperative. Check the circuit breaker, if it is out, reset it. If the generator is still inoperative, turn if OFF and continue the flight after turning on the good generator.

(2) Two generators out. If neither generator can be made operational by resetting the circuit breakers, turn off all non-essential equipment, including the generators and land as soon as practicable. Under this condition, the use of any electrical equipment will cause a drain on the batteries until battery power is exhausted.

c. Inverter Failure. U-8D RU-8D If inverter failure is suspected observe the following procedures:

(1) Three phase inverter failure. (Indicated by the illumination of the 3-phase warning light or a warning flag on the gyro compass.)

1. 3-phase inverters switch — STANDBY.

2. 3-phase inverter circuit breaker (warning flag still noted) — Reset. (If the circuit breaker cannot be reset, neither the MAIN nor the STANDBY inverter will operate and the warning light will not illuminate. Allow at least a 30-second cooling period before resetting.)

3. Inverters switch (warning flag still noted) — Return to MAIN inverter.

4. Inverter switch (warning flag still noted) — OFF. Continue flight, using the magnetic compass and copilot's attitude indicator.

(2) Single phase inverter failure. (Indicated by the illumination of the 1-PHASE warning light and a warning flag on the glideslope indicator.)

1. 1-Phase inverters switch — STANDBY.

2. Single phase inverter circuit breaker (warning flag still noted) — RESET. (The circuit breaker controls both inverters and the warning light. Allow at least a 30-second cooling period before resetting.)

3. Inverters switch (warning flag still noted) — Return to MAIN inverter.

4. Inverters switch (warning flag still noted) — OFF. Continue flight without use of the glideslope.

9-10. Emergency Descent.

Emergency descent is a maximum effort in which damage to the aircraft must be considered secondary to getting the aircraft down. For emergency descent, proceed as follows:

CAUTION

Do not practice EMERGENCY DESCENT procedure. This rapid descent may cause damage to the aircraft or engines.

1. Propeller levers — Low pitch.

2. Throttles — Closed.

3. Gear — UP.

4. Flaps — UP.

5. Airspeed — Vmo (230 KIAS).

NOTE

These steps will cause a controlled rate of descent of approximately 4,000 feet per minute.

9-11. Landing Emergencies.

WARNING

The heater must be shut down prior to all emergency landings to minimize fire hazards.

The following paragraphs indicate action to be taken in landing emergencies.

NOTE

If all three landing gear cannot be fully extended and locked, landing should be made with the landing gear retracted.

a. Landing Gear System Failure. Should one or more of the landing gear fail to extend or fail to indicate a safe condition, the following steps should be taken before proceeding manually to lower the gear:

CAUTION

If the landing gear motor circuit breaker is tripped, allow approximately three minutes cooling time before resetting.

1. Gear relay circuit breaker — Check.

2. Indicator bulbs — Check.

3. Nose gear indicator — Check.

4. Gear motor circuit breaker — Check.

5. Gear handle — Recycle.

6. Gear position — Check (use air-to-air or air-to-ground fly-by method for visual landing gear position verification).

CAUTION

Proceed cautiously when nearing full extension of landing gear, and stop when indicator lights illuminate or when resistance to the handle is felt. Further movement of the handle could damage the drive mechanism and prevent subsequent retraction of the landing gear electrically.

b. Landing Gear Emergency Extension. The landing gear may be extended manually if the normal electrical gear extension system fails. When making an emergency gear extension, proceed as follows:

1. Gear relay circuit breaker — Out.

2. Airspeed — Below 130 KIAS.

3. Gear handle — DOWN.

4. Gear emergency clutch lever — Full right.

5. Gear emergency extension handle — Pump the handle approximately 150 complete fore-and-aft cycles to extend and lock the landing gear. No provisions are made for manual emergency retraction of the landing gear.

WARNING

During gear-up landing, RU-8D dipole antennas will strike landing surface before the wheels resulting in wing damage. The possible breakaway of one or both antennas should be anticipated. Excessive nose high attitude at touchdown will result in the impact of the tail bumper with landing surface followed by a rapid forward rocking motion. Pilot should attempt to make a wings level, slight nose high attitude landing.

c. Gear Up Landing — All Gear Up or Unlocked. All three wheels protrude slightly from the aircraft in the gear-up position and will roll when the aircraft is landed. The clearance between aircraft and ground during a belly landing will result in a minimum of structural damage providing touchdown is gentle and the wings are kept level. It is recommended that the landing be made on hard surface, preferably paved runway. In landing on soft ground or dirt, sod has a tendency to roll up into chunks, damaging the underside of the aircraft's structure. Brakes are available on a gear-up landing. When making a gear-up landing, proceed as follows:

1. Crew/passengers emergency briefing — Completed.

2. Seat belts and shoulder harnesses — Secure (crew/passengers checked).

3. Gear relay circuit breaker — In.

4. Gear handle — UP.

5. Heater — OFF.

6. Approach — NORMAL.

7. Flaps (before touchdown) — Down.

8. Throttles — Closed when runway ured.

9. Mixture levers — Idle cutoff.

10. Propellers — FEATHER.

11. Brakes — As required.

(1) Landing with main gear down and locked, nose gear up or unlocked. If the nose landing gear indicators show an unsafe condition, the nose gear is probably not locked down, and landing gear position should be checked visually by tower or other aircraft if possible. If all attempts to lock the nose gear fail, retract the main gear, complete GEAR-UP LANDING procedure, and execute a gear-up landing. If the main landing gear cannot be retracted, make a normal approach with power on using a minimum of wing flaps to hold nose up longer after landing. Touch down gently on a smooth, hard surface, if possible, since sod and soft surfaces tend to roll up under the nose with possibility of cartwheeling. Hold the nose up as long as possible with the control column all the way back, and do not use brakes. Perform normal BEFORE LANDING CHECKS. Use the following procedure as applicable:

1. Crew/passengers emergency briefing — Completed.

2. Seat belts and shoulder harnesses — Secure (crew/passenger checked).

3. Heater — OFF.

4. Before landing checks — Completed.

5. Throttles — Closed when runway assured.

6. Mixture levers — Idle cutoff.

7. Propellers — FEATHER.

8. Brakes — Do not use.

(2) Landing with one main gear up or unlocked. If one main landing gear fails to extend and the opposite landing gear extends normally, a break in the drive train to the unextended landing gear is indicated and it will not be possible to lower it. If all efforts to retract the extended landing gear fail, land the aircraft on runway or firm, hard ground in preference to loose dirt or grass. Touchdown smoothly, on the same side of the runway as the extended gear to allow room for eventual ground loop. Roll on the down and locked landing gear, holding the opposite wing up and the nose straight as long as possible. As the wingtip strikes the ground, apply opposite brake

hard to maintain a straight path of the aircraft. Evacuate the aircraft as soon as possible. Use the following procedures:

1. Crew/passengers emergency briefing — Completed.

2. Seat belts and shoulder harnesses — Secure (crew/passengers checked).

3. Heater — OFF.

4. Before landing check — Completed.

5. Throttles — Closed when runway assured.

6. Touchdown — On good gear.

7. Mixture levers — Idle cutoff.

8. Propellers — FEATHER.

9. Brakes — As required.

CAUTION

The RU-8D maximum bank angle while landing is 5°.

(3) Landing with nose gear down, main gear up or unlocked. Complete the same approach and procedures as used for GEAR-UP LANDING.

CAUTION

While landing the RU-8D with a flat tire, the maximum bank angle, without causing antenna damage is 4°.

d. Landing With Flat Tire. When landing is made with a flat tire on one main landing gear, the aircraft will turn into the flat tire; therefore, directional control must be maintained with the opposite brake. If aware that a main landing gear tire is flat, a landing on the side of the runway opposite the flat tire will help avoid veering off the runway. If the nose wheel is flat, nose wheel stability will be reduced and applications of brakes should be only as required to maintain positive control. Use the following procedures:

1. Land on side of runway favoring good tire.

2. Brake — On good wheel only.

3. Flat nose tire — Use light braking.

CAUTION

Due to mission antenna configuration, landing RU-8D on unprepared surfaces should be avoided except in extreme emergencies.

e. Landing on Unprepared Runway. Procedures used for landing on unprepared surfaces are similar to those used for minimum run landings. Use caution in applying brakes to eliminate undue strain on the landing gear. Raise the wing flaps as soon as possible to prevent damage from loose rocks or sod being picked up by the propellers. Use minimum power when taxiing, and avoid stopping in loose sand or dirt where considerable power may be required to move the aircraft.

9-12. Ditching.

As the aircraft contacts the water several impacts will be felt; a slight one when the tail contacts the water and a second, more severe impacts as the nose hits. Several lesser impacts will be felt as the aircraft glances on the surface of the water. Do not relax ditching positions or unfasten seat belts until the aircraft is definitely at rest. Figure 9-1 or 9-2 shows the location and operation of emergency exits and personnel departure sequence. Evacuate the aircraft as quickly as possible since it will probably stay afloat only a few seconds. If the decision to ditch the aircraft (figure 9-5) is made, proceed as follows:

1. Radio — Distress procedure.

2. Crew/passengers emergency briefing — Completed.

3. Seat belts and shoulder harnesses — Secure (crew/passengers checked).

4. Gear — UP.

5. Flaps — DOWN (30°).

PLANNED DITCHING

PILOT

A. ALERT CREW

B. ORDER TO PREPARE SURVIVAL GEAR FOR AERIAL DROP

C. TRANSMIT DISTRESS MESSAGE

D. NOTIFY CABIN OCCUPANTS TO JETTISON CABIN ENTRANCE DOOR AND EMERGENCY WINDOWS

E. LIFE VEST - CHECK (DO NOT INFLATE)

F. DISCHARGE MARKER

G. NOTIFY CREW TO DROP SURVIVAL GEAR

H. SHOULDER HARNESS INERTIA REEL LOCK LEVER - LOCKED

I. LAND AND DITCH AIRCRAFT

J. ABANDON AIRCRAFT AFTER COPILOT THROUGH CABIN ACCESS DOOR

COPILOT

A. CABIN ENTRANCE DOOR - JETTISON

B. WITH NO CABIN OCCUPANTS ON FLIGHT, DROP SURVIVAL GEAR BEFORE LANDING

C. LIFE VEST - CHECK (DO NOT INFLATE)

D. SHOULDER HARNESS INERTIA REEL LOCK LEVER - LOCKED

IMMEDIATE DITCHING

PILOT SEAT PILOT

A. WARN OCCUPANTS

B. NOTIFY CABIN OCCUPANTS TO JETTISON CABIN ENTRANCE DOOR AND EMERGENCY WINDOWS

C. TRANSMIT DISTRESS MESSAGE

D. SHOULDER HARNESS INERTIAL REEL LOCK LEVER - LOCKED

E. LIFE VEST - CHECK (DO NOT INFLATE)

F. APPROACH - NORMAL

G. NOTIFY OCCUPANTS TO BRACE FOR DITCHING

H. LAND AND DITCH AIRCRAFT

I. ABANDON AIRCRAFT AFTER COPILOT THROUGH CABIN ACCESS DOOR

COPILOT SEAT COPILOT

A. CABIN ENTRANCE DOOR - JETTISON

B. LIFE VEST - CHECK (DO NOT INFLATE)

C. SHOULDER HARNESS INERTIA REEL LOCK LEVER - LOCKED

D. ABANDON AIRCRAFT THROUGH CABIN ENTRANCE DOOR

Figure 9-5. Ditching Chart (Sheet 1 of 2)

PASSENGERS

A. CABIN ENTRANCE DOOR AND EMERGENCY WINDOWS - JETTISON

B. SURVIVAL GEAR - PREPARE FOR AERIAL DROP

C. SEAT BELTS - FASTEN

D. LIFE VEST - CHECK (DO NOT INFLATE)

E. ON PILOTS SIGNAL - DROP SURVIVAL GEAR

F. ABANDON AIRCRAFT THROUGH CABIN DOOR OR EMERGENCY EXIT WINDOW ENTRANCE

PASSENGERS

A. CABIN ENTRANCE DOOR AND EMERGENCY WINDOWS - JETTISON

B. SEAT BELTS - FASTEN

C. LIFE VEST - CHECK (DO NOT INFLATE)

D. ON PILOTS SIGNAL - BRACE FOR DITCHING

E. ABANDON AIRCRAFT THROUGH CABIN ENTRANCE DOOR OR EMERGENCY EXIT WINDOWS

Figure 9-5. Ditching Chart (Sheet 2 of 2)

6. Heater — OFF.

(O) 7. Voice security — ZEROIZE.

8. Approach — Normal, (power on, if possible).

IMMEDIATELY BEFORE IMPACT, perform the following:

9. Throttles — Closed.

10. Mixture levers — Idle cutoff.

a. Ditching Procedures For Pilot.

1. Alert all personnel to "prepare for ditching."

2. Transmit distress message.

3. Check personal survival equipment and life vest (do not inflate). Fasten shoulder harness and seat belt; loosen collar.

4. Order all on board to "secure for ditching."

5. Give verbal warning immediately before impact.

6. Supervise evacuation.

7. Exit by a route indicated on figure 9-1 or 9-2 and account for all personnel.

b. Ditching Procedures for Copilot.

1. Secure any loose equipment in the cabin.

2. Check personal survival equipment and life vest (do not inflate). Fasten shoulder harness and seat belt; loosen collar.

3. Exit by route indicated on figure 9-1 or 9-2 and assist in evacuating personnel and survival equipment (life raft, flashlight, and first aid kits).

c. Ditching Procedures For Passengers.

1. Stow loose gear.

2. Check personal survival equipment and life vest (do not inflate); loosen collar.

3. Cabin emergency exit hatch — Jettison (on pilot's command).

4. Tighten seat belt.

5. Exit by routes indicated on figure 9-1 or 9-2 and assist in evacuating survival equipment.

9-13. Bailout.

CAUTION

All occupants should make sure clothing and personal gear are not fouled on harness before leaving their seats.

When the decision has been made to abandon the aircraft in flight, the pilot will give the warning signal. Exit from the aircraft will be through the main entrance door (on U-8G aircraft, through the bailout, ditching and ground exit emergency door). Departure sequence will use the exit routes indicated in figures 9-1 and 9-2. Proceed as follows if bailout becomes necessary.

1. Radio — Distress procedure (if time permits).

2. Right front seat emergency release handle — Pull (to permit tilting seat forward for exit from the rear seat).

3. Airspeed — Reduce.

4. Flaps — DOWN (30°).

5. Trim — As required.

6. Cabin entrance door — Jettison.

7. Abandon the aircraft.

Section II. MISSION EQUIPMENT

There are no emergency procedures for mission equipment.

APPENDIX A

REFERENCES

Reference information for the subject material contained in this manual can be found in the following publications:

AR 70-50	Designating and Naming Defense Equipment, Rockets, and Guided Missiles
AR 95-1	Army Aviation - General Provisions and Flight Regulations
AR 95-16	Weight and Balance - Army Aircraft
AR 380-40	Safeguarding COMSEC Information
AR 385-40	Accident Reporting and Records
FAR Part 91	General Operating and Flight Rules
FM 1-5	Instrument Flying and Navigation for Army Aviators
FM 1-30	Meteorology for Army Aviators
FM 55-413	Aerial Recovery of U.S. Army and U.S. Air Force Aircraft
TB 55-1500-314-25	Handling, Storage, and Disposal of Army Aircraft Components Containing Radioactive Materials
TB 55-9150-200-25	Recommended Fuels, Engine and Transmission Oil for Army Aircraft
TBAVN 23-13	Anti-icing, Deicing and defrosting Procedures for Parked Aircraft
TBMED 251	Noise and Conservation of Hearing
TM 11-6140-203-15-2	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual, Including Repair Parts and Special Tools Lists: Aircraft Nickel-Cadmium Batteries
TM 38-750	Army Maintenance Management System
TM 55-405-9	Army Aviation Maintenance Manual: Weight and Balance
TM 55-410	Aircraft Maintenance, Service and Ground handling Under Extreme Environmental Conditions
TM 55-1500-204-25/1	General Aircraft Maintenance Manual
TM 55-1510-201 ESC	Equipment Serviceability Criteria
TM 55-1510-201-20	Organization Manual: Army Models U-8D, U-8G, RU-8D and U-8F Aircraft
TM 750-244-1-5	Procedures for the Destruction of Aircraft and Associated Equipment to Prevent Enemy Use

APPENDIX B

ABBREVIATIONS AND TERMS

For the purpose of this manual, the following abbreviations and terminologies apply. See appropriate technical manuals for additional terms.

Approved Loading Envelope	Those combinations of aircraft weight and center-of-gravity which define the limits beyond which loading is not approved.
ASAC	Authorized Standard Avionic Configuration.
Best Angle-of-Climb	The best angle-of-climb speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance with gear and flaps up.
Best Rate-of-Climb	The best rate-of-climb speed is the airspeed which delivers the greatest gain of altitude in the shortest possible time with gear and flaps up.
CAS	Calibrated airspeed is indicated airspeed of an aircraft, corrected for position error.
Climb Gradient	The ratio of the change in height during a portion of a climb, to the horizontal distance traversed in the same time interval.
Cruise Climb	Power recommended for cruise climb.
Datum	A vertical plane perpendicular to the aircraft longitudinal axis from which fore and aft (usually aft) measurements are made for weight and balance purposes.
Demonstrated Crosswind	The maximum 90° crosswind component for which adequate control of the aircraft during takeoff and landing was actually demonstrated during certification tests.
IAS	Indicated airspeed is the speed of an aircraft as shown on its airspeed indicator. As used within this manual IAS assumes no instrument error.
Landing Weight	The aircraft weight at touchdown.
Loading Condition	That combination of aircraft weight and corresponding moment applicable to the various loadings computed for weight and balance purposes.
Manifold Pressure Gage	An instrument that measures the pressure in the intake manifold of an engine, measured from zero, and expressed in inches of mercury (in. Hg.)
Maximum Cruise Power	Is the highest power rating for cruise and is not time limited.
Maximum Weight	The largest weight allowed by design, structural, performance or other limitations.
Propeller Governor	This governor will maintain the selected speed requested by the propeller control lever.
Propeller Lever	This lever requests the control to maintain RPM at a selected value and, in the maximum decrease RPM position, feathers the propellers.
Ramp Weight	The gross weight of the aircraft before engine start. Included is the takeoff weight plus a fuel allowance for start, taxi, runup and takeoff ground roll to lift-off.

Service Ceiling	The altitude at which the maximum rate-of-climb of 100 feet-per-minute can be attained for existing aircraft weight.
Standard	Weights corresponding to the aircraft as offered with seating and interior, avionics, accessories, fixed ballast and other equipment specified by the manufacturer as composing a standard aircraft.
Station	The longitudinal distance from some point to the zero datum or zero fuselage station.
Tachometer	An instrument that indicates the rotation of the propeller in revolutions per minute (RPM).
Tare	The apparent weight which may be indicated by a scales before any load is applied.
Takeoff or Maximum Continuous	Highest power rating not limited by time.
Takeoff Weight	The aircraft weight at lift-off.
Throttle Control	Is the lever used to control the forced introduction of a fuel-air mixture into the intake passages of an engine by means of a pressure differential other than that caused by the induction airflow in the engine.
Unusable Fuel	The fuel remaining after consumption of usable fuel.
Usable Fuel	That portion of the total fuel which is available for consumption as determined in accordance with applicable regulatory standards.
Useful Load	The difference between the aircraft ramp weight and the basic empty weight.
Wind	The wind velocities recorded as variables on the charts of this manual are to be understood as the headwind or tailwind components of the actual winds at 500 feet above runway surface (tower winds).
Zero Fuel Weight	The aircraft ramp weight minus the weight of fuel on board.

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RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)
PFC JOHN DOE
CoA, 3d ENGINEER BN
FT. LEONARD WOOD MO 63108

DATE: 16 DEC 74

PUBLICATION NUMBER	DATE	TITLE
TM5-6115-200-20 AND P	1 APR 72	GENERATOR SET 10 KW NSN 6115-00-231-7286

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.	IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
6	2-1 a			In line 6 of paragraph 2-1a the manual states the engine has 6 cylinders. The engine on my set only has 4 cylinders. Change the manual to show 4 cylinders
81		4-3		Callout 16 on figure 4-3 is pointing at a bolt. In the key to fig. 4-3, item 16 is called a shim. Please correct one or the other.
125	line 20			I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got what I ordered so the NSN is wrong. Please give me a good NSN

SAMPLE

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER: JOHN DOE, PFC (268) 317-7111

SIGN HERE: John Doe

DA FORM 1 AUG 74 2028-2 (TEST)

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RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)

DATE

PUBLICATION NUMBER	DATE	TITLE
TM 55-1510-201-10/4		Army Model U-8D, U-8G and RU-8D Aircraft

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 1 AUG 74 2028-2 (TEST)

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TEAR ALONG DOTTED LINE

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Materiel Readiness Command
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REVERSE OF DA FORM 2028-2 (TEST)

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimenter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigrams = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 38.82 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimenter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*
inches	centimeters	2.540
feet	meters	.305
yards	meters	.914
miles	kilometers	1.609
square inches	square centimeters	6.451
square feet	square meters	.093
square yards	square meters	.836
square miles	square kilometers	2.590
acres	square hectometers	.405
cubic feet	cubic meters	.028
cubic yards	cubic meters	.765
fluid ounces	milliliters	29,573
pints	liters	.473
quarts	liters	.946
gallons	liters	3.785
ounces	grams	28.349
pounds	kilograms	.454
short tons	metric tons	.907
pound-feet	newton-meters	1.365
pound-inches	newton-meters	.11375

To change	*To*	*Multiply by*
ounce-inches	newton-meters	.007062
centimeters	inches	3.94
meters	feet	3.280
meters	yards	1.094
kilometers	miles	.621
square centimeters	square inches	.155
square meters	square feet	10.764
square meters	square yards	1.196
square kilometers	square miles	.386
square hectometers	acres	2.471
cubic meters	cubic feet	35.315
cubic meters	cubic yards	1.308
milliliters	fluid ounces	.034
liters	pints	2.113
liters	quarts	1.057
liters	gallons	.264
grams	ounces	.035
kilograms	pounds	2.205
metric tons	short tons	1.102

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C